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Manual of

ICU DRUGS

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TO WHOM I BELONG

TO MY GREAT FATHER, WHO PUSH ME TO BE UNIQUE.

TO MY GREAT MOTHER, THE UNLIMITED LOVE.

Preface to the first edition

My dear teachers, Colleagues, may I introduce this little effort to help you about common ICU drugs , all drugs included here are discussed by the same regime :-

1-Administration routs.
2- ICU indications.
3-Presentation and administration .
4- Compatible fluid that can be given with .
5-Storage .
6-Dosage ,dosage in renal failure and renal replacement therapy ,dosage in pediatrics
7- Clinical pharmacology (what is this drug) .
8-Laboratory Tests (tests that should be done while using that drug) .
9- Contraindications .
10-Special warning.
11- Precaution and drug reactions.

Thanks and I am waiting your advice

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1- ADMINISTRATION ROUTES:-

IV

2-CLINICAL PHARMACOLOGY:-

- Adenosine slows conduction time through the A-V node, can interrupt the reentrypathways through the AV node, and can restore normal sinus rhythm in patients withparoxysmal supraventricular tachycardia (PSVT), including PSVT associated with Wolff-Parkinson-White Syndrome.
- Intravenously administered adenosine is rapidly cleared from the circulation via cellularuptake, primarily by erythrocytes and vascular endothelial cells.
- Adenosine has a half-lifeof less than 10 seconds in whole blood

3- ICU INDICATIONS:-

- Conversion of paroxysmal supraventricular tachycardia (PSVT)to sinus rhythm, including that associated with accessory bypass tracts (Wolff-Parkinson-White Syndrome).

4-PRESENTATION AND ADMINISTRATION:-

- Adenosine comes in a vial containing 6mg in 2mls solution
- Compatible with Normal Saline
- Store at room temperature

Note :– Do Not Refrigerate as crystallization may occur.
The solution must be clear at the time of use.

5-DOSAGE:-

- Adenosine injection should be given as a rapid bolus by the peripheral IV route.
- It should be given as close to the patient as possible and followed by a rapid saline flush(this is best achieved by using a three-way tap system)
- The recommended IV doses for adults are as follows:

a- Initial dose:

6 mg given as a rapid IV bolus (administered over a 1-2 second period).

b - Repeat administration:

If the first dose does not result in elimination of the supraventricular tachycardia within1-2 minutes, 12 mg should be given as a rapid IV bolus. This 12 mg dose may be repeated a second time if required.

Note- Central venous administration of adenosine has not been systematically studied; however, in the ICU setting this route of administration is acceptable.

6-DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

No dosage adjustment is required in renal failure or renal replacement therapy.

7-DOSAGE IN PAEDIATRICS:-

a- Pediatric Patients with a Body Weight < 50 kg:

- Initial dose:-

Give 0.05 to 0.1 mg/kg as a rapid IV bolus given either centrally or peripherally. A saline flush should follow.

- Repeat administration:-

If conversion of PSVT does not occur within 1-2 minutes, additional bolus injections of adenosine can be administered at incrementally higher doses, increasing the amount given by 0.05 to 0.1 mg/kg. Follow each bolus with a saline flush.

- This process should continue until sinus rhythm is established or a maximum single dose of 0.3 mg/kg is used.

b - Paediatric Patients with a Body Weight > 50 kg:-

Administer the adult dose.

8- CONTRAINDICATIONS:-

i- Second- or third-degree A-V block (except in patients with a functioning Artificial pacemaker).

ii- Sinus node disease, such as sick sinus syndrome or symptomatic Bradycardia (except in patients with a functioning artificial pacemaker).

iii- Known hypersensitivity to adenosine.

9- WARNINGS :-

i - Heart Block

Adenosine injection exerts its effect by decreasing conduction through the A-V node andmay produce a short lasting first-, second- or third-degree heart block.

Appropriate therapy should be instituted as needed. Patients who develop high-level block on onedose of adenosine should not be given additional doses. Because of the very short halflifeof adenosine, these effects are generally self-limiting.

ii - Asystole and VF

Transient or prolonged episodes of asystole have been reported with fatal outcomes in some cases. Rarely, ventricular fibrillation has been reported following adenosine administration, including both resuscitated and fatal events. In most instances, these cases were associated with the concomitant use of digoxin and, less frequently with digoxin and verapamil. Although no causal relationship or drug-drug interaction hasbeen established, adenosine should be used with caution in patients receiving digoxin or digoxin and verapamil in combination.

iii- Arrhythmias at Time of Conversion

At the time of conversion to normal sinus rhythm, a variety of new rhythms may appear on the electrocardiogram. They generally last only a few seconds without intervention, and may take the form of premature ventricular contractions, atrial premature contractions, sinus bradycardia, sinus tachycardia, skipped beats, and varying degreesof A-V nodal block. Such findings are seen in 55% of patients.

iv-Bronchoconstriction

Adenosine has been administered to a limited number of patients with asthma and mildto moderate exacerbation of their symptoms has been reported. Adenosine should beused with caution in patients with obstructive lung disease or asthma. Adenosine shouldbe discontinued in any patient who develops severe respiratory difficulties.

10-PRECAUTIONS :-

Digoxin with or without verapamil use may be rarely associated with ventricular fibrillation when combined with adenosine .

Note - The effects of adenosine are antagonised by methylxanthines such as caffeine and theophylline. In the presence of these methylxanthines, larger doses of adenosine maybe required or adenosine may not be effective.

- Adenosine effects are potentiated by dipyridamole (persantin). Thus, smaller doses of adenosine may be effective in the presence of dipyridamole.
- Carbamazepine has been reported to increase the degree of heart block produced byadenosine.

11-ADVERSE REACTIONS :-

The half-life of adenosine is less than 10 seconds. Thus, adverse effects are generallyrapidly self-limiting.

- Body as a Whole:-
  Apprehension
- Cardiovascular System:-
  Facial flushing, headache, sweating, palpitations, chest pain, hypotension
- Respiratory System:
  Bronchospasm, shortness of breath/dyspnea, chest pressure
- Digestive System:
  Nausea, metallic taste, tightness in throat, pressure in groin.
- Nervous System:
  Lightheadedness, dizziness, tingling in arms, numbness, blurred vision, Burning sensation

ADRENALINE :-

1- ADMINISTRATION ROUTES:-

IV, IM, SC, NEBULISED

2- CLINICAL PHARMACOLOGY:-

- Adrenaline is a sympathomimetic drug. It activates an adrenergic receptive mechanism on effector cells and imitates all actions of the sympathetic nervous system except those on the arteries of the face and sweat glands.
- Adrenaline acts on both alpha and beta receptors.

3**- ICU INDICATIONS:-**

i- Cardiac arrest
ii- Anaphylaxis
iii- Upper airway obstruction
iv- Inotrope / vasopressor

4 - PRESENTATION AND ADMINISTRATION:-

i- IV

- Adrenaline comes in vials containing 1mg in 1ml (1:1000) and vials containing 1mgIn10ml (1:10000).
- The standard dilution for adrenaline by infusion in the ICU is 10mg in 100ml Of Normal saline, D5W .
- Store at room temperature. Protect from light.
- Do not refrigerate.
- Solutions that are discolored pink or brown should not be used.

ii- IM

Although IM use is said to be preferred in anaphylaxis and other emergencies, the IV route is generally more appropriate in the ICU setting. Use 1:1000 solution undiluted for administration by the IM route.

iii- Nebulized

Use 1:1000 solution and (if required) make up to a total of 5ml using normal saline prior to administration

5-DOSAGE:-

Cardiac arrest:-

10ml of 1:10000 (i.e 1mg) IV
OR
3-10mg of 1:1000 via ETT can be used if IV access cannot be obtained

Anaphylaxis:-

0.05ml/kg of 1:10000 IV with dose titrated to effect followed by IV infusion if required.
OR
0.01ml/kg of 1:1000 IM (avoid administration in the buttocks)

Post-extubation stridor or other upper airway obstruction :-

Use the 1:1000 vials up to max. dose 5ml and administer via a nebulizer.

- IV Infusion:-

10mg in 100ml of D5W or normal saline at up to 20ml/hr titrated to effect

6-DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

No dosage adjustment is required in renal failure or renal replacement therapy.

7-DOSAGE IN PAEDIATRICS:-

-Cardiac arrest:-

0.1ml/kg of 1:10000 IV

OR

0.1ml/kg of 1:1000 via ETT

-Anaphylaxis:-

0.05ml/kg of 1:10000 IV

OR

0.01ml/kg of 1:1000 IM

-Severe Croup:-

Use the 1:1000 vials at a dose of 0.5ml/kg/dose, max. dose 5ml and administer via a nebulizer (make up to at least 4ml with 0.9% saline).

-IV Infusion:- 0.3mg/kg in 50ml D5W at 0.5-10ml/hr (0.05-1mcg/kg/min)

8- CONTRAINDICATIONS:-

There are no absolute contraindications to the use of adrenaline in a life-threatening situation.

9- WARNINGS :-

- Adrenaline by infusion commonly leads to hyperlactataemia and hyperglycemia.
- Adrenaline by infusion may worsen dynamic outflow tract obstruction and Paradoxically reduce cardiac output (particularly if used in the setting of hypovolaemia)

10-PRECAUTIONS :-

i- General

Some patients may be at greater risk of developing adverse reactions after adrenaline administration. These include: hyperthyroid individuals, individuals with cardiovascular disease, hypertension, or diabetes, and the elderly.

11- Laboratory Tests:-

Adrenaline infusion commonly leads to increased lactate. It may be necessary to measure lactate levels if there are clinical concerns.

12-IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

The effects of adrenaline may be potentiated by tricyclic antidepressants and

monoamine oxidase inhibitors.

13- ADVERSE REACTIONS :-

- Body as a Whole:-
  Apprehension, nervousness, anxiety and sweating.
- Cardiovascular System:-
  Palpitations, tachycardia, pallor.
- Respiratory System:-
  Hyperventilation, pulmonary edema
- Digestive System:-
  Nausea and vomiting,
- Nervous System:-
  Headache, tremor, dizziness, weakness, cerebrovascular haemorrhage.

AMINOPHYYLLINE :-

1- ADMINISTRATION ROUTES:-

IV

2- CLINICAL PHARMACOLOGY:-

- Aminophylline is a 2:1 complex of theophylline and ethylenediamine. The activity is of theophylline alone. Theophylline directly relaxes the smooth muscle of the bronchial airway and pulmonary blood vessels, thus acting mainly as a bronchodilator and smooth muscle relaxant.
- It has also been demonstrated that aminophylline has a potent effect on diaphragmatic contractility in normal persons and may then be capable of reducing fatigability and therapy improve contractility in patients with chronic obstructive airway disease.
- The exact mode of action remains unsettled.

3- ICU INDICATIONS:-

Management of acute life threatening asthma (particularly in children)

4- PRESENTATION AND ADMINISTRATION:-

- IV:
- 250mg/10ml (solution).
- For adult administration dilute 500mg in 500ml of normal saline,D5W, D10W, and Sodium chloride to make a concentration of 1mg/ml.
- Store at room temperature 15-30°C; protect from light

Note: Do not mix with other medications – many medications will precipitate if mixed With aminophylline.

5- DOSAGE:-

i- Asthma and COPD

IV aminophylline is very rarely used for treatment in asthma or COPD in adults In our Intensive Care Unit. The dilution when used for adults is 500mg in 500ml of compatible IV fluid (i e 1mg/ml) at 0.5-1mg/kg/hr (usually 0 - 40ml/hr).

ii - Dose adjustment for obesity

Theophylline does not distribute into fatty tissue. Dosage should be calculated on the basis of lean (ideal) body weight.

Note:- Do not use standard dosing for IV infusion if the patient is already on oral Theophylline; dosage should be worked out after determining the Serum concentration.

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

While dose adjustment in renal failure is possible, dosage is complex and the risk of toxicity is high. Aminophylline should be ceased if the patient develops significant renal impairment.

7-DOSAGE IN PAEDIATRICS:-

i- Aminophylline Infusion in Life threatening asthma

a- Dose if patient aged 1 – 9 years:

-1.1 mg/kg/hour

b- Dose if patient aged 10 – 15 years and weight < 35 kg:

- 0.7 mg/kg/hour

c- Dose if patient aged 10 – 15 years and weight > 35 kg

- 0.7 mg/kg/hour

8- CONTRAINDICATIONS:-

i- Hypersensitivity to either aminophylline or ethylenediamine.
ii-Active peptic ulcer disease
iii- Underlying seizure disorders (unless receiving appropriate anticonvulsant medications).

9- WARNINGS :-

- In individuals in whom theophylline plasma clearance is reduced for any reason, Even conventional doses may result in increased serum levels and potential toxicity.
- Reduced theophylline clearance has been documented in the following readily identifiable groups:
  - i- patients with impaired liver function;
  - ii- patients over 55 years of age, particularly males and those with chronic lung disease;
  - iii- those with cardiac failure from any cause;
  - iv- patients with sustained high fever;
  - v- neonates and infants under 1 year of age; and
  - vi- those patients taking certain drugs .
- Serious side effects such as ventricular arrhythmias, convulsions or even death May appear as the first sign of toxicity without any previous warning.
- A serum concentration measurement is the only reliable method of predicting potentially life-threatening toxicity.
- Theophylline products may cause or worsen arrhythmias and any significant change in rate and/or rhythm warrants measurement of a serum level and consideration of cessation of the drug.

10-Laboratory Tests:-

Sampling Time, anytime after 12 hours on infusion.

11-Drug/Laboratory Test Interactions :-

Acetazolamide interferes with the HPLC method of assay for theophylline. Interference with the theophylline assay by acetazolamide depends on the solvent used in the extraction; acetazolamide may not interfere with other assay methods for theophylline.

12-IMPORTANT DRUG INTERACTIONS FOR THE ICU:-

Aminophylline With:-

i- Allopurinol (high-dose): Increased serum theophylline levels
ii- Ciprofloxacin: Increased serum theophylline levels
iii- Erythromycin: Increased serum theophylline levels
iv- Lithium carbonate: Increased renal excretion of lithium
v- Oral contraceptives: Increased serum theophylline levels

vi- Phenytoin: Decreased theophylline and phenytoin serum levels
vii- Propranolol: Increased serum theophylline levels
viii-Rifampin: Decreased serum theophylline levels
ix- Increased toxicity may be seen with combinations of high dose beta agonists and aminophylline.

13-ADVERSE REACTIONS :-

- Body as a Whole:
  Irritability, restlessness, insomnia
- Cardiovascular System:
  Palpitation, tachycardia, extrasystoles, flushing, hypotension, circulatory failure, ventricular arrhythmias.
- Respiratory System:
  Tachypnoea.
- Digestive System:
  Nausea, vomiting, epigastric pain, haematemesis, diarrhoea.
- Nervous System:
  Headaches, reflex hyperexcitability, muscle twitching, clonic and tonic Generalized convulsions.

AMIODARONE :-

1- ADMINISTRATION ROUTES:-

PO, NG, IV

2- CLINICAL PHARMACOLOGY:-

Amiodarone is generally considered a Class III antiarrhythmic drug, but it Has electrophysiologic characteristics of all four Vaughan Williams classes.

3- ICU INDICATIONS:-

i- VT, VF

ii- Atrial tachycardias

4- PRESENTATION AND ADMINISTRATION:-

- PO / NG

  200mg tablets; tablets may be crushed for NG administration

- IV
  - 150mg in 3ml vials. Cordarone IV is a sterile clear, pale-yellow solution visually freefrom particulate matter.
  - Compatible with **D5W only**
  - Do not use PVC infusion bags for infusion as adsorption may occur.
  - Administration via a central line is preferred
  - Store at room temperature; do not refrigerate.

5**- DOSAGE:-**

a- Tachydysrhythmias:-

- IV load 300-450 mg in 100ml D5W over 20 minutes to two hours
- Ongoing infusion:

  450mg in 250ml glucose 5% over 12 hours x 2 i.e. 900mg over 24 hours diluted in glucose 5% only using Excel Container 250ml 5% Dextrose Injection USP.

Note - 300mg stat may be considered for VT/VF (this should be added to 10-20ml of D5W and administered by slow IV push over 3 minutes or more)

- Transition from IV to oral therapy:-

  200mg PO 8 hourly for 1 week followed by 200mg PO 12 hourly for one week Followed by 200mg PO 12-24 hourly thereafter

Note - higher oral dosages (up to 1600mg per day can be used in patients who Have not received a full IV load).

- An overlap of intravenous and oral medication of up to two days is recommended.

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS:-

The safety and efficacy of amiodarone in the paediatric population have not Been established; therefore, its use in paediatric patients is not recommended.

8- CONTRAINDICATIONS:

i- Known hypersensitivity to any of the components of amiodarone, including iodine.

ii-Second- or third-degree AV block unless a functioning pacemaker is available.

9- WARNINGS :-

- Hypotension

Hypotension is the most common adverse effect seen with amiodarone. Hypotension should be treated by vasopressor drugs, positive inotropic agents, and volume expansion. Slowing the rate of infusion may also be effective.

- Bradycardia and AV Block

Drug-related bradycardia should be treated by discontinuing amiodarone. Additional measures including drug therapy and/or temporary pacing may be required if bradycardia does not resolve.

10- PRECAUTIONS :-

General

- Liver enzyme elevations in patients on amiodarone are not uncommon; however,baseline abnormalities in hepatic enzymes are not a contraindication to treatment. Rare cases of fatal hepatocellular necrosis after treatment with amiodarone have been reported.
- Like all antiarrhythmic agents, amiodarone may cause a worsening of existing arrhythmias or precipitate a new arrhythmia.
  There have been reports of acute-onset (days to weeks) pulmonary injury in Patients treated with amiodarone. Findings have included pulmonary infiltrates on X-ray,bronchospasm, wheezing, fever, dyspnea, cough, haemoptysis, and hypoxia. Some cases have progressed to respiratory failure and/or death.

11-Laboratory Tests:-

Consider measurement of thyroid function as a baseline (if not measured previously).

12-Drug/Laboratory Test Interactions :-

Amiodarone alters the results of thyroid-function tests, causing an increase in serum T4and serum reverse T3, and a decline in serum T3 levels.
Despite these biochemical changes, most patients remain clinically euthyroid.

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Amiodarone with:

i- Cyclosporin: increased cyclosporin levels; dosage reduction of cyclosporine required
ii- Digoxin: increased digoxin levels; dosage reduction of digoxin required.
iii- Antiarrhythmics: in general, any added antiarrhythmic drug should be initiated at a Lower than usual dose with careful monitoring.
iv- Antihypertensives: beta blockers and calcium channel blockers may lead to increasedrisk of bradycardia when combined with amiodarone
vi- Warfarin: dose of warfarin should be reduced by 1/2 to 1/3rd and INR shouldbe closely monitored
vii- Rifampin: decreases in serum concentrations of amiodarone.

viii- Fluoroquinolones: increased risk of QTc prolongation when combined with amiodarone

ix- Macrolides: increased risk of QTc prolongation when combined withamiodarone

14-ADVERSE REACTIONS :-

- Body as a Whole:
  Fever
- Cardiovascular System:
  Bradycardia, congestive heart failure, hypotension, ventricular tachycardia
- Respiratory System:
  Dyspnea, cough, haemoptysis, wheezing, hypoxia, pulmonary infiltrates
- Digestive System:
  Nausea, deranged LFTs
- Nervous System:
  Hallucinations, confusional state, pseudotumour cerebri
- Endocrine System:
  Hypothyroidism, hyperthyroidism, SIADH
- Skin:
  Toxic epidermal necrolysis

Aspirin :-

1- ADMINISTRATION ROUTES:-

- PO, NG

2- CLINICAL PHARMACOLOGY:-

- Aspirin is a salicylate that has demonstrated antiplatelet, antinflammatory, Analgesic and antipyretic activity.

3- ICU INDICATIONS:-

i- Antiplatelet therapy for cardiovascular and cerebrovascular disease

4 - PRESENTATION AND ADMINISTRATION:

- PO:

Asprin 300mg tablets (non-enteric coated) or Aspirin 100mg (enteric coated) .Store at room temperature.

5- DOSAGE:-

- PO:

For intubated patients use . a 300mg Asprin tablet daily crushed and administered via NG tube; for non-intubated patients use Aspirin 100mg (enteric coated) daily.

6**- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-**

Dose as in normal renal function

7 - DOSAGE IN PAEDIATRICS:-

- PO:-

-Analgesia / antipyretic : 10-15mg/kg 4-6 hr;

-Kawasaki: 10mg/kg 6hrly (low dose) OR 25mg/kg 6hrly (high dose) for 2 weeks then3-5mg/kg daily

8- CONTRAINDICATIONS:-

i- Hypersensitivity to aspirin.

ii-Gastrointestinal bleeding.

9- WARNINGS :-

Subclinical GI blood loss is common; frank GI bleeding may occur

10- PRECAUTIONS :-

-General

Aspirin tablets should be administered with caution to patients with asthma, Nasal polyps, or nasal allergies.

11- Laboratory Tests:-

No tests in addition to routine ICU tests are indicated.

12- Drug/Laboratory Test Interactions :-

Salicylates can produce changes in thyroid function tests.

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

i- Oral hypoglycaemics :

Large doses of salicylates have a hypoglycaemic action and may enhance the effect of the oral hypoglycaemics.

ii- Phenytoin:

Serum phenytoin levels may be increased by aspirin.

iii- Anticoagulants:

Combination with other anticoagulants increases the risk of bleeding

14- ADVERSE REACTIONS :-

- Body as a Whole:
  Headache and fever, anaphylaxis.
- Digestive System:
  Dyspepsia, thirst, nausea, vomiting, diarrhoea, acute reversible hepatotoxicity, gastrointestinal bleeding, and/or ulceration.
- Nervous System:
  Mental confusion, drowsiness, and dizziness
- Skin:
  Urticaria, angioedema, and pruritus.
- Haematological System:
  Prolongation of bleeding time, leukopaenia, thrombocytopaenia, purpura, Decreased plasma iron concentration and shortened erythrocyte survival time.
- Special Senses:
  Tinnitus, vertigo, reversible hearing loss, and dimness of vision.

ATRACURIUM :-

1- ADMINISTRATION ROUTES:-

IV

2- CLINICAL PHARMACOLOGY:-

Atracurium besylate is an intermediate-duration, non depolarizing, skeletal muscle relaxant. Elimination of atracurium is not dependent on renal clearance mechanisms and no dose adjustment is required in renal impairment

3- ALTERNATIVE NAMES:-

Tracrium

4- ICU INDICATIONS:-

- Muscle Relaxant

5- PRESENTATION AND ADMINISTRATION:-

- IV

-50mg in 5ml solution, sterile, non-pyrogenic aqueous solution.
Each ml contains 10 mg atracurium besylate.

-Administer neat for IV injection or infusionCompatible with Normal saline 5% dextrose and sodium chloride .

NOTE - only compatible in Hartmanns for 4 hours therefore do not use by infusion

- Atracurium besylate slowly loses potency with time at the rate of approximately 6%/year under refrigeration. Atracurium besylate should be refrigerated at 2-8°C to preserve potency.
- Rate of loss in potency increases to approximately 5%/month at 25°C. Upon removal from refrigeration to room temperature storage Conditions, use atracurium besylate within 14 days even if re-refrigerated.

6- DOSAGE:-

IV

- 0.3-0.6mg/kg stat (usually give 50mg) then 0.1-0.2mg/kg when required or 5-9mcg/kg/min.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:

- IV

0.3-0.6mg/kg stat then 0.1-0.2mg/kg when required or 5-10mcg/kg/min

9- CONTRAINDICATIONS:-

i- Hypersensitivity to atracurium

10- WARNINGS :-

- Although atracurium besylate is a less potent histamine releaser than d-tubocurarine ormetocurine, the possibility of substantial histamine release in sensitive individualsmustbe considered.
- Special caution should be exercised in administering atracurium besylate to patients in whom substantial histamine release would be especially hazardous (e.g., patients with clinically significant cardiovascular disease) and in patients with any history (e.g., severe anaphylactoid reactions or asthma) suggesting agreater risk of histamine release.

11- PRECAUTIONS

- Atracurium besylate may have profound effects in patients with myasthenia gravis, Eaton-Lambert syndrome, or other neuromuscular diseases in which

potentiation of nondepolarizing agents has been noted.

- The use of a peripheral nerve stimulator isespecially important for assessing neuromuscular block in these patients.
- When there is a need for long-term mechanical ventilation, the benefits-to-risk ratio of neuromuscular block must be considered. Little information is available on the plasma levels and clinical consequences of atracurium metabolites that may accumulate during days to weeks of atracurium administration in ICU patients.
- Laudanosine, a major biologically active metabolite of atracurium without neuromuscular blocking activity, produces transient hypotension and, in higher doses, cerebral excitatory effects(generalized muscle twitching and seizures) when administered to several species of animals.
- There have been rare spontaneous reports of seizures in ICU patients who have received atracurium or other agents.

12- Laboratory Tests:-

- No tests additional to routine ICU tests are required

13- Drug/Laboratory Test Interactions :-

- None known

14-IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Drugs which may enhance the neuromuscular blocking action of atracurium besylate include:-

- certain antibiotics, especially the aminoglycosides and polymyxins; lithium; magnesium salts; procainamide; and quinidine.
- The prior administration of succinylcholine does not enhance the duration, but quickens the onset and may increase the depth, of neuromuscular block induced by atracurium besylate.

15- ADVERSE REACTIONS :-

- General
  Allergic reactions (anaphylactic or anaphylactoid responses) which, in rare instances, were severe (e.g., cardiac arrest).
- Musculoskeletal
  Inadequate block, prolonged block.
- Cardiovascular
  Hypotension, vasodilatation (flushing), tachycardia, bradycardia.
- Respiratory
  Dyspnea, bronchospasm, laryngospasm.
- Skin
  Rash, urticaria, reaction at injection site.

ATROPINE :-

1- ADMINISTRATION ROUTES:-

- IV, IM, SC, ENDOTRACHEAL

2- CLINICAL PHARMACOLOGY:-

Atropine is commonly classified as an anticholinergic or antiparasympathetic (parasympatholytic) drug. More precisely, however, it is termed an antimuscarinic agent Since it antagonizes the muscarine-like actions of acetylcholine (which is ,bradycardia, VD, bronchoconstriction , increased secresions, tremors and fasciculation's .

3 - ICU INDICATIONS:-

i- To temporarily increase heart rate or decrease AV-block until definitive

intervention can take place
ii- As an antidote for inadvertent overdose of cholinergic drugs or for cholinesterase poisoning such as from organophosphorus insecticides

4- PRESENTATION AND ADMINISTRATION:-

- Atropine vials contain 500mcg (0.5mg) in 1ml Dilution in IV fluids is not recommended Atropine sulphate is stated to be compatible, when mixed in a syringe immediatelybefore use, with the following:Chlorpromazine, Droperidol, Fentanyl, Glycopyrrolate, Metoclopramide, Midazolam, Morphine, Pethidine Prochlorperazine Promethazine Ranitidine
- If the solution is cloudy, do not use.
- Store at room temperature below 25°C

5- DOSAGE:-

IV

- Bradycardia: 0.5mg IV
- Organophosphate poisoning: 2mg IV then 2mg every 15 minutes until atropinised, then 0.02-0.08mg/kg/hr for several days

-Endotracheal route(only if IV access cannot be obtained)

The recommended adult dose of atropine for endotracheal administration is 1 to 2 mg diluted to a total not to exceed 10 ml of sterile water or normal saline.

Note: The administration of less than 0.5 mg can produce a paradoxical bradycardia because of the central or peripheral parasympathomimatic effects of low dose in adults.

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS:-

IV

Bradycardia: 0.02mg/kg

8- CONTRAINDICATIONS:-

There are no absolute contraindications to atropine. However, atropine is Relatively contraindicated in:

i- pyloric stenosis
ii- glaucoma
iii-prostatic hypertrophy

9- WARNINGS :-

- In adults, the administration of less than 0.5 mg can produce a paradoxical Bradycardia because of the central or peripheral parasympathomimatic effects of low dose in adults.
- Conventional systemic doses may precipitate acute glaucoma in susceptible patients,convert partial organic pyloric stenosis into complete obstruction, lead to completeurinary retention in patients with prostatic hypertrophy or cause

inspissation of bronchialsecretions and formation of dangerous viscid plugs in patients with chronic lungdisease.

10– PRECAUTIONS :-

See WARNINGS above

11- Laboratory Tests:-

No laboratory tests in addition to routine tests are required.

12- Drug/Laboratory Test Interactions

None known

13-IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

None of note.

14-ADVERSE REACTIONS

- Body as a Whole:
  Thirst
- Cardiovascular System:
  Tachycardia
- Gastrointestinal System:
  Dryness of the mouth, constipation
- Neurological System:
  Blurred vision, dilated pupils, difficulty in swallowing, tremor,
- Urological System:
  Difficulty in micturition

Ca CHLORIDE :-

1- ADMINISTRATION ROUTES:-

IV, 10% solution (i.e. 1gm calcium chloride/10ml)= 6.8 mmol ofcalcium per 10ml.

2- ICU INDICATIONS:-

i- Hypocalaemia (particular if there is refractory shock or bleeding)
ii- ECG abnormalities caused by hyperkalaemia (acts as a membrane stabiliser)
iii-Magnesium toxicity

3- PRESENTATION AND ADMINISTRATION:-

IV

- Preferably give via a central line (if this is present)Injection undiluted solution.
- 1gm calcium chloride/10ml (i.e. 10% solution)= 6.8 mmol ofcalcium per 10ml.
- Calcium chloride is a clear colourless solution
- For direct IV injection, inject undiluted solution at a rate not exceeding 0.5-

1ml/min (0.35– 0.7 mmol of calcium per minute) = (1amp over 10 minutes).
- For intermittent infusion, add 1gm of calcium chloride to 50ml of compatible IV fluid , Administer at a rate not exceeding 0.35-0.7mmol of calcium per minute (50-100mg/min).but, for a 2% solution the maximum rate range is 2.5-5ml/min
- Compatible with D5W , normal saline
- Stored Room temperature below 30°C

4- DOSAGE:-

IV

- Usually give one vial and repeat as necessary.

Note :- 1 vial of calcium chloride contains approximately three times the amount of calcium that is present in a vial of calcium gluconate.

5- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

6- DOSAGE IN PAEDIATRICS:-

0.2ml/kg (max 10ml)

7- CONTRAINDICATIONS:-

i- Hypercalcaemia,
ii- Digitalis toxicity.
iii- Hyperphosphataemia (do not administer calcium if the Calcium + Phosphate is >5.5; this is an indication for dialysis)

8- WARNINGS :-

- Calcium chloride should be injected into a large vein very slowly, as it may cause peripheral vasodilatation and a cutaneous burning sensation (it is preferable to administer it centrally if the patient has a central line)
- Avoid IV calcium in patients on digoxin where possible due to the risk of Inducing digoxin toxicity.

9- PRECAUTIONS :-

General

- Calcium chloride injection, 10% is irritating to veins and must not be injected intotissues, since severe necrosis and sloughing may occur.
- Great care should be taken toavoid extravasation or accidental injection into perivascular tissues.

10- Laboratory Tests:-

- An arterial or venous blood gas should be repeated after administration of Calciumchloride to check the ionised calcium.

11- Drug/Laboratory Test Interactions:-

None known

12- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Hypercalcaemia increases the risk of digitalis toxicity. Because of the danger Involvedin the simultaneous use of calcium salts and drugs of the digitalis

group, a digitalizedpatient should not receive intravenous injections of calcium unless the indications areclearly defined.

13- ADVERSE REACTIONS :-

The major side effects are those due to hypercalcaemia as a result of inadvertent overdosing.

a-Early:

- Weakness, headache, somnolence, nausea, vomiting, dry mouth, constipation, musclepain, bone pain, metallic taste, and anorexia.

b-Late:

Polyuria, polydipsia, anorexia, weight loss, nocturia, conjunctivitis (calcific), pancreatitis,photophobia, rhinorrhea, pruritus, hyperthermia, decreased libido, elevated Cr,albuminuria, hypercholesterolemia, elevated AST and ALT, ectopic calcification,nephrocalcinosis, hypertension, cardiac arrhythmias, dystrophy, sensory disturbances, dehydration, apathy, arrested growth, urinary tract infections, and, rarely, overtpsychosis.

Ca GLUCONATE :-

1- ADMINISTRATION ROUTES:-

- IV, calcium gluconate 10% solution (i.e. 1gm calcium gluconate/10ml) =2.2mmol of calcium per 10ml.

2- ICU INDICATIONS:-

i- Hypocalaemia (particular if there is refractory shock or bleeding)
ii- ECG abnormalities caused by hyperkalaemia (acts as a membrane stabiliser)
iii- Magnesium toxicity

3- PRESENTATION AND ADMINISTRATION:-

IV

- Preferably give via a central line (if this is present)Injection undiluted solution.
- 1gm calcium gluconate/10ml (i.e. 10% solution). 2.2mmolof calcium per 10ml.
- Calcium gluconate is a clear colourless solution
- For direct IV injection, inject undiluted solution at a rate not exceeding 2ml/min
- For intermittent infusion, add 1gm of calcium gluconate to 50ml of compatible

IV fluid and administer over 10 to 20 minutes.
- Compatible with:D5W normal saline glucose and Hartmanns
- Store at room temperature below 30°C

4- DOSAGE:-

IV

-Usually give one vial and repeat as necessary.

Note :-1 vial of calcium gluconate contains approximately one third the amount of calcium that is present in a vial of calcium chloride.

5- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

6- DOSAGE IN PAEDIATRICS:-

0.5ml/kg (max 20ml)

7- CONTRAINDICATIONS:-

i- Hypercalcaemia,
ii- Digitalis toxicity.

8- WARNINGS :-

- Calcium gluconate should be injected into a large vein very slowly, as it may causeperipheral vasodilatation and a cutaneous burning sensation (it is preferable toadminister it centrally if the patient has a central line)
- Avoid IV calcium in patients on digoxin where possible due to the risk of Inducing digoxin toxicity.

9– PRECAUTIONS :-

General

- Calcium gluconate injection, 10% is irritating to veins and must not be injected intotissues, since severe necrosis and sloughing may occur.
- Great care should be taken toavoid extravasation or accidental injection into perivascular tissues.

10- Laboratory Tests:-

- An arterial or venous blood gas should be repeated after administration of calciumchloride to check the ionised calcium.

11- Drug/Laboratory Test Interactions:-

None known

12- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Hypercalcaemia increases the risk of digitalis toxicity. Because of the danger Involvedin the simultaneous use of calcium salts and drugs of the digitalis group, a digitalizedpatient should not receive intravenous injections of calcium unless the indications areclearly defined.

13- ADVERSE REACTIONS :-

The major side effects are those due to hypercalcaemia as a result of inadvertent

overdosing.

a- Early:

Weakness, headache, somnolence, nausea, vomiting, dry mouth, constipation, musclepain, bone pain, metallic taste, and anorexia.

b- Late:

Polyuria, polydipsia, anorexia, weight loss, nocturia, conjunctivitis (calcific), pancreatitis,photophobia, rhinorrhea, pruritus, hyperthermia, decreased libido, elevated Cr,albuminuria, hypercholesterolemia, elevated AST and ALT, ectopic calcification,nephrocalcinosis, hypertension, cardiac arrhythmias, dystrophy, sensory disturbances,dehydration, apathy, arrested growth, urinary tract infections, and, rarely, overtpsychosis.

CLOPIDOGREL :-

1- ADMINISTRATION ROUTES:-

PO, NG

2- CLINICAL PHARMACOLOGY:-

Clopidogrel is a platelet aggregation inhibitor. It selectively inhibits the bindin of adenosine diphosphate (ADP) to its platelet receptor and the subsequent ADP-mediatedactivation of the glycoprotein GPIIb/IIIa complex, thereby inhibiting platelet aggregation.

3- ICU INDICATIONS:-

i- Treatment of acute coronary syndromes (especially post angioplasty when stents are deployed)

ii- Prophylaxis of vascular ischaemic events .

4- PRESENTATION AND ADMINISTRATION:-

PO

Plavix 75mg tablets

5- DOSAGE:-

PO/NG

- 300mg loading dose followed by 75mg daily Plavix brand clopidogrel can be crushed, mixed with water and administered via anasogastric tube.

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS:-

PO

1.5mg/kg daily

8- CONTRAINDICATIONS:-

i- Hypersensitivity to clopidogrel

ii- Active bleeding

9- WARNINGS :-

Thrombotic Thrombocytopenic Purpura (TTP)

TTP has been reported rarely following use of clopidogrel bisulfate, sometimes after ashort exposure (<2 weeks). TTP is a serious condition that can be fatal and requiresurgent treatment including plasmapheresis (plasma exchange). It is characterised bythrombocytopaenia, microangiopathic haemolytic anaemia (schistocytes [fragmented RBCs] seen on peripheral smear), neurological findings, renal dysfunction, and fever.

10- PRECAUTIONS :-

General

-Clopidogrel bisulfate prolongs the bleeding time and therefore should be used withcaution in patients who may be at risk of increased bleeding from trauma, surgery, orother pathological conditions (particularly gastrointestinal and intraocular).

- If a patient isto undergo elective surgery and an antiplatelet effect is not desired, clopidogrel bisulfateshould be discontinued 5 days prior to surgery.
- In patients with recent TIA or stroke who are at high risk for recurrent ischemic events,the combination of aspirin and clopidogrel has not been shown to be more effective thanclopidogrel alone, but the combination has been shown to increase major bleeding.
- In CAPRIE, clopidogrel bisulfate was associated with a rate of gastrointestinal bleedingof 2.0% vs 2.7% on aspirin. In CURE, the incidence of major gastrointestinal bleedingwas 1.3% vs 0.7% (clopidogrel bisulfate + aspirin versus placebo + aspirin,respectively).
- Clopidogrel bisulfate should be used with caution in patients who have lesions with a propensity to bleed (such as ulcers).

11- Laboratory Tests:-

No tests in addition to routine ICU tests are indicated

12- Drug/Laboratory Test Interactions:-

None noted

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- The risk of bleeding increases when clopidogrel is combined with other anticoagulants.
- Omeprazole and other PPIs decrease the antiplatelet effect of clopidogrel.
- It may bemore appropriate to use Ranitidine as ulcer prophylaxis in patients on clopidogrel.
- Ifclopidogrel is used concomitantly with a PPI the dosages should be separated by 12hours.

14- ADVERSE REACTIONS

- Body as a Whole
  Bleeding, anaphylaxis, angioedema, serum sickness, fatigue
- Haematological
  TTP, leucopenia, eosinophilia
- Gastrointestinal System:
  Pancreatitis, stomatitis, colitis
- Respiratory System
  Interstitial pneumonitis, bronchospasm
- Skin:
  Rash

DESMOPRESSIN :-

1- ADMINISTRATION ROUTES:-

IV, IM, SC, Intranasal

2- CLINICAL PHARMACOLOGY:-

Desmopressin is a synthetic analogue of the natural pituitary hormone arginine vasopressin (ADH), an antidiuretic hormone affecting renal water conservation.

3- ALTERNATIVE NAMES:-

Minirin

4- ICU INDICATIONS:-

i- Treatment of central diabetes insipidus
ii- Prevention and control of bleeding (primarily when there are thought to be platelet function defects especially uraemia, clopidogrel or cardiopulmonary bypass -related)

5 - PRESENTATION AND ADMINISTRATION:-

IV

- Minirin 4mcg/ml injection
- Doses of 4mcg or less should be administered undiluted by direct IV injection.

- Forsmall doses (eg 0.4mcg), 4mcg can be diluted in 10 ml of normal saline.
- For doses of greater than 4mcg in adults or children weighing more than 10kg,
- dilutewith 50ml of normal saline and infuse the first 5ml slowly over 5 minutes.
- For childrenweighing less than 10kg, dilute in 10ml of normal saline and infuse the first 1-2ml over 5minutes.
- If no marked tachycardia or other adverse effects are observed, give the remainder slowly over 15 minutes.

PO
- Minirin 0.1mg tablets

Nasal Spray
- Desmopressin spray (10mcg/dose), Minirin spray (10mcg/dose), Octostim (150mcg/dose)

5– DOSAGE:-

IV

i- Central diabetes insipidus:
0.4mcg repeated as required (may increase the dose if there is an adequate response)

ii- Prevention and control of bleeding:
0.3mcg/kg (max 24mcg) over 30 minutes (once only)

Note:- although IM and SC routes can be used, IV is generally the preferred route.

PO
- 0.1mg -1.2mg daily depending on indication (rarely used by this route in ICU)

Nasal Spray
Not generally administered by this route in ICU

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- CONTRAINDICATIONS:-

i- Hypersensitivity to desmopressin
ii-Hyponatraemia

8- WARNINGS :-

- When desmopressin acetate injection is administered to patients who do not have needof antidiuretic hormone for its antidiuretic effect, in particular in paediatric and geriatricpatients, fluid intake should be adjusted downward to decrease the potential occurrenceof water intoxication and hyponatraemia.
- Particular attention should be paid to the possibility of the rare occurrence of an extremedecrease in plasma osmolality that may result in seizures which could lead to coma.

9- PRECAUTIONS :-

General

-Desmopressin acetate injection has infrequently produced changes in blood pressurecausing either a slight elevation in blood pressure or a transient fall in blood pressureand a compensatory increase in heart rate.

-The drug should be used with caution inpatients with coronary artery insufficiency and/or hypertensive cardiovascular disease.

-There have been rare reports of thrombotic events following desmopressin acetateSevere allergic reactions have been reported rarely.

- Anaphylaxis has been reportedrarely with desmopressin.

10- Laboratory Tests:-

Laboratory tests for monitoring the patient include urine volume and osmolality. In somecases, plasma osmolality may be required.

11- Drug/Laboratory Test Interactions:-

None of note

12- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

DDAVP may cause minor increases in blood pressure requiring changes in levels Of vasopressor support.

13 - ADVERSE REACTIONS :-

- Central Nervous System
  transient headache, ischaemic stroke
- Cardiovascular System
  changes in blood pressure causing either a slight elevation or a transient fall and acompensatory increase in heart rate, myocardial infarction
- Gastrointestinal System
  nausea, mild abdominal cramps
- Metabolic and Endocrine System
  water intoxication and hyponatraemia.
- Skin
  Local irritation at site of injection

DEXAMETHASONE :-

1- ADMINISTRATION ROUTES:-

IV, PO

2- CLINICAL PHARMACOLOGY:-

- Dexamethasone is a glucorticoid which is 25 times more potent than Hydrocortisonewith respect to its glucocorticoid activity; it has no mineralocorticoid effect.
- Naturally occurring glucocorticoids (hydrocortisone and cortisone), which also have salt-retainingproperties, are used as replacement therapy in adrenocortical deficiency states.
- Theirsynthetic analogs, including dexamethasone, are primarily used for their potent anti- inflammatory effects in disorders of many organ systems.

3- ICU INDICATIONS:-

i- Cerebral oedema
ii- Upper airway oedema
iii- Nausea and vomiting
iv- Croup
v- Other inflammatory conditions

4- PRESENTATION AND ADMINISTRATION:-

IV

- 4mg/1ml vial and 8mg/2ml vial
- Inject undiluted over 3-5 minutes

- Compatible with 0.9% Sodium chloride and 5% Dextrose
- Store at room temperature.
- Protect from light and freezing.

PO

1mg and 4mg tablets

5- DOSAGE:-

IV/PO

i- Cerebral oedema:

8-16mg stat, then 4-8mg 4 hourly reducing over 3-5 days to 2mg 8 to 12 hourly

ii-Nausea:

4-8mg IV stat

iii-dult airway oedema:

8-16mg 1hr pre extubation (may be repeated 8 hourly)

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS:-

IV / PO

i- Cerebral oedema:
0.25-1mg/kg stat then 0.1-0.2mg/kg 4 hourly reducing over 3-5 days to 0.05mg/kg 8-12hourly

ii- Severe croup or extubation stridor:
0.6mg/kg stat IV, then 1mg/kg prednisilone 8-12 hourly

8- CONTRAINDICATIONS:-

i- Systemic fungal infections

ii- Hypersensitivity to dexamethasone or any component of the product

9- WARNINGS :-

i- Anaphylaxis

Anaphylactoid and hypersensitivity reactions have been reported for dexamethasonesodium phosphate injection as it contains sodium bisulfite, a sulfite that maycause allergic-type reactions including anaphylactic symptoms and life-threatening orless severe asthmatic episodes in certain susceptible people.

The overall prevalence ofsulfite sensitivity in the general population is unknown and probably low. Sulfitesensitivity is seen more frequently in asthmatic than in nonasthmatic people.

ii- Exacerbation of fungal infections

Corticosteroids may exacerbate systemic fungal infections and therefore should not beused in the presence of such infections unless they are needed to control drug reactionsdue to amphotericin B.

iii- Relative steroid deficiency

In patients on corticosteroid therapy subjected to any unusual stress, increased dosageof rapidly acting corticosteroids before, during, and after the stressful situation isindicated. Drug-induced secondary adrenocortical insufficiency may result from toorapid withdrawal of corticosteroids and may be minimized by gradual reduction ofdosage. This type of relative insufficiency may persist for months after discontinuation oftherapy; therefore, in any situation of stress occurring during that period, hormonetherapy should be reinstituted.

iv- Masking of signs of infection

Corticosteroids may mask some signs of infection, and new infections may appear during their use.

10- PRECAUTIONS :-

General

Psychic derangements may appear when corticosteroids are used, ranging from euphoria, insomnia, mood swings, personality changes, and severe depression to frankpsychotic manifestations. Also, existing emotional instability or psychotic tendenciesmay be aggravated by corticosteroids.

11- Laboratory Tests:-

No tests in addition to routine ICU tests are indicated

12- Drug/Laboratory Test Interactions:-

None known

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Phenytoin, phenobarbital, ephedrine, and rifampin may enhance the metabolic clearance of corticosteroids resulting in decreased blood levels and lessened physiologic activity, thus requiring adjustment in corticosteroid dosage.

14 - ADVERSE REACTIONS :-

- Fluid and electrolyte disturbances

Sodium retention; fluid retention; congestive heart failure in susceptible patients;potassium loss; hypokalemic alkalosis; hypertension.

- Musculoskeletal

Muscle weakness; steroid myopathy; loss of muscle mass; osteoporosis; vertebralcompression fractures; aseptic necrosis of femoral and humeral heads; pathologicfracture of long bones; tendon rupture.

- Gastrointestinal

Peptic ulcer with possible subsequent perforation and haemorrhage; perforation of thesmall and large bowel, particularly in patients with inflammatory bowel disease;pancreatitis; abdominal distention; ulcerative oesophagitis.

- Dermatologic

Impaired wound healing; thin fragile skin; petechiae and ecchymoses; erythema;increased sweating; may suppress reactions to skin tests; burning or tingling, especiallyin the perineal area (after IV injection); other cutaneous reactions, such as allergicdermatitis, urticaria, angioneurotic edema.

- Neurologic

Convulsions; increased intracranial pressure with papilloedema (pseudotumour cerebri)usually after treatment; vertigo; headache; psychic disturbances.

- Endocrine

Menstrual irregularities; development of Cushingoid state; suppression of growth inchildren; secondary adrenocortical and pituitary unresponsiveness, particularly in timesof stress, as in trauma, surgery, or illness; decreased carbohydrate tolerance;manifestations of latent diabetes mellitus; increased requirements for insulin or oralhypoglycaemic agents in diabetics; hirsutism.

- Metabolic

Negative nitrogen balance due to protein catabolism

- Cardiovascular

Myocardial rupture following recent myocardial infarction

- Others

Anaphylactoid or hypersensitivity reactions; thromboembolism; weight gain; increasedappetite; nausea; malaise; hiccups.

DIAZEPAM :-

1-ADMINISTRATION ROUTES:-

IV, IM, PO, PR

2- CLINICAL PHARMACOLOGY:-

Diazepam is a benzodiazepine. As with other benzodiazepines it has anticonvulsant,anxiolytic, sedative and muscle relaxant properties.

3- ICU INDICATIONS:-

i- Agitation
ii- Alcohol and benzodiazepine withdrawal
iii- Seizures

4- PRESENTATION AND ADMINISTRATION:-

PO

- Calmepam 1.5 ,3 mg tablet

IV

- 10mg/2ml vial
- Inject undiluted solution slowly at a rate not exceeding 5mg/min (avoid injecting intosmall veins)

Note:-In general, diazepam should not be mixed or diluted with other drugs or added to IVfluids. However, if IV infusion is required, diazepam in doses up to 20mg can be addedto at least 250ml of 5% dextrose or normal saline.

- Do not use any solution that iscloudy.

Store at room temperature and protect from light.

IM

Injection by this route is painful and absorption is slow and erratic. This route

should beavoided where possible. If the *IM* route is used, inject undiluted.

5- DOSAGE:-

IV, PO or PR:
Usual dose 2-20mg 8-12 hourly

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  - <10- use small doses and titrate to response
  - 10-20 - use small doses and titrate to response
  - >20-50 - dose as in normal renal function
- Dose in renal replacement therapy
  - CAPD - use small doses and titrate to response
  - HD - use small doses and titrate to response

7-DOSAGE IN PAEDIATRICS:-

- IV or PR
  - 0.1-0.4mg/kg
- PO
  - 0.04-0.2mg/kg 8-12 hourly; pre-med 0.2-0.4mg/kg oral

8- CONTRAINDICATIONS:-

- Hypersensitivity to diazepam

9- WARNINGS :-

- Extreme care must be used in administering diazepam by the IV route to the elderly, to very ill patients and to those with limited pulmonary reserve because of the possibility that apnoea and/or cardiac arrest may occur. Concomitant use of barbiturates, alcohol or other central nervous system depressants increases depression with increased risk of apnoea.
- Tonic status epilepticus has been precipitated in patients treated with IV diazepam For petit mal status or petit mal variant status.

10- PRECAUTIONS :-

General

- Although seizures may be brought under control promptly, a significant proportion Of patients experience a return to seizure activity, presumably due to the short-lived effect of diazepam after IV administration.
- Diazepam is not recommended for maintenance,and once seizures are brought under control, consideration should be given to the administration of agents useful in longer term control of seizures.
- Withdrawal may precipitate seizures.

11- Laboratory Tests:-

No tests in addition to routine ICU tests are indicated

13- Drug/Laboratory Test Interactions:-

None known.

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Increased CNS depression is seen when diazepam is combined with other CNS depressant drugs

15- ADVERSE REACTIONS :-

- Central Nervous System

Confusion, drowsiness, ataxia, depression, dysarthria, headache, hypoactivity, slurred speech, syncope, tremor, vertigo. Paradoxical reactions such as acute hyperexcited states, anxiety, hallucinations, increased muscle spasticity, insomnia, rage, sleep disturbances and stimulation have been reported; should these occur, use of the drug should be discontinued. Minor changes in EEG patterns, usually low-voltage fast activity, have been observed in patients during and after diazepam therapy and are ofno known significance.

- Gastrointestinal System:

Constipation, nausea, jaundice.

- Genitourinary System:

Incontinence, urinary retention.

- Cardi*ovascular System:*

Bradycardia, cardiovascular collapse, hypotension

- Skin:

Urticaria, skin rash.

- Haematological System:

Neutropaenia

DIGOXIN:-

1- ADMINISTRATION ROUTES:-

IV, PO

2- CLINICAL PHARMACOLOGY:-

- Lanoxin (digoxin) is one of the cardiac (or digitalis) glycosides, a closely related group ofdrugs having in common specific effects on the myocardium.
- Digoxin inhibits sodiumpotassiumATPase, an enzyme that regulates the quantity of sodium and potassium inside cells. Inhibition of the enzyme lead to an increase in the intracellular concentration of sodium and thus (by stimulation of sodium-calcium exchange) an increase in the intracellular concentration of calcium.
- The beneficial effects of digoxin result from direct actions on cardiac muscle, as well as indirect actions on the cardiovascular system mediated by effects on the autonomic nervous system.

3- ICU INDICATIONS:

i- Atrial fibrillation
ii- Cardiac failure

4- PRESENTATION AND ADMINISTRATION:-

PO

Lanoxin PG tablets 62.5mcg tablets , Lanoxin 250mcg tablets , Lanoxin Paediatric Elixir 50mcg/ml.

IV

-Digoxin 500mcg/2mlSolution may be injected slowly over at least 10-20 minutes. Alternatively, dilute required dose to four or more times its volume (eg 2ml with at least 8ml of diluent) with dextrose 5%, normal saline, glucose and sodium chloride or water for injection and administer slowly over at least 10-20 minutes.

- The preferred method of administration is to add the required dose to 50-100mlof compatible IV fluid and to infuse over at least 10-20 minutes but preferably two or more hours.
-Discard any solution not used within 24 hours of preparation.
- Store at room temperature and protect from light.
- Compatible with Normal saline 5% dextrose glucose .

5- DOSAGE:-

IV

- Digitalising (loading) dose: 500mcg; followed by 250mcg 6 hours later and a Further 250mcg 6 hours after that

IV/PO

- Oral loading:
  750-1500mcg 1-2 doses 6 hours apart

- Maintenance dose:
  62.5mcg – 250mcg daily

Note: when converting from the oral to the IV formulation the dosage should be reduced by 33% to take account of the difference in bioavailability

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  <10 62.5mcg - three times a week to 62.5mcg daily
  10-20 - usually 125mcg daily
  >20-50 - usually 125mcg daily

- Dose in renal replacement therapy
  CAPD - 62.5mcg three times a week to 62.5mcg daily
  HD 62.5mcg - three times a week to 62.5mcg daily

Note: for patients with renal impairment interval between doses given during digitalisation should be lengthened to for example 8-10 hours**.**

7- DOSAGE IN PAEDIATRICS:

IV

Digitalising (loading) dose: 15mcg/kg stat and then 5mcg/kg after 6 hours

IV/PO

Maintenance dose:3-5mcg/kg 12 hourly

Note: when converting from the oral to the IV formulation the dosage should be reduced by 33% to take account of the difference in bioavailability

8- CONTRAINDICATIONS :-

Hypersensitivity to digoxin

9- WARNINGS :-

i- Sinus Node Disease and AV Block

Because digoxin slows sinoatrial and AV conduction, the drug commonly prolongs the PR interval. The drug may cause severe sinus bradycardia or sinoatrial block in patients with pre-existing sinus node disease and may cause advanced or complete heart block in patients with pre-existing incomplete AV block. In such patients consideration should be given to the insertion of a pacemaker before treatment with digoxin.

ii- Accessory AV Pathway (Wolff-Parkinson-White Syndrome)

After intravenous digoxin therapy, some patients with paroxysmal atrial fibrillation or flutter and a coexisting accessory AV pathway have developed increased antegrade conduction across the accessory pathway bypassing the AV node, leading to a very rapid ventricular response or ventricular fibrillation.

10- PRECAUTIONS :-

- General

i- Use in Patients With Electrolyte Disorders

In patients with hypokalaemia or hypomagnesemia, toxicity may occur despite Serum digoxin concentrations below 2.0 ng/ml, because potassium or magnesium depletionsensitizes the myocardium to digoxin. Therefore, it is desirable to maintain normalserum potassium and magnesium concentrations in patients being treated with digoxin.

ii- Hypercalcaemia from any cause predisposes the patient to digitalis toxicity.

Calcium,particularly when administered rapidly by the intravenous route, may produce seriousarrhythmias in digitalized patients. On the other hand, hypocalcaemia can nullify theeffects of digoxin in humans; thus, digoxin may be ineffective until serum calcium isrestored to normal.

iii- Use in Thyroid Disorders and Hypermetabolic States

Hypothyroidism may reduce the requirements for digoxin. Heart failure and/or Atrial arrhythmias resulting from hypermetabolic or hyperdynamic states (e.g., hyperthyroidism, hypoxia, or arteriovenous shunt) are best treated by addressing the underlying condition. Atrial arrhythmias associated with hypermetabolic states areparticularly resistant to digoxin treatment. Care must be taken to avoid toxicity if digoxinis used.

11- Laboratory Tests:-

Digoxin toxicity may develop in the critically ill, particularly if the patient has renal impairment. Monitoring is not routinely required but should be considered.Therapeutic Range 0.6-1.2 nmol/L. Recommended sampling: 8-24 hours post dose. If a patient is commenced on digoxin in the ICU levels should not be measured until the drug has achieved steady state at 5-7 days.

12- Drug/Laboratory Test Interactions:-

None if note

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Potassium-depleting diuretics are a major contributing factor to digitalis toxicity.Calcium, particularly if administered rapidly by the intravenous route, may produceserious arrhythmias in digitalized patients.
- Quinidine, verapamil, amiodarone, propafenone, indomethacin, itraconazole,

alprazolam, and spironolactone raise the serum digoxin concentration due to a reduction in clearance and/or in volume of distribution of the drug, with the implication that digitalis intoxication may result. Erythromycin and clarithromycin (and possibly other macrolide antibiotics) and tetracycline may increase digoxin absorption in patients who inactivate digoxin by bacterial metabolism in the lower intestine, so that digitalis intoxication may result. Rifampin may decrease serum digoxin concentration, especially in patients with renal dysfunction, by increasing the non-renal clearance of digoxin.

14- ADVERSE REACTIONS :-

- Cardiovascular System

  Ventricular extrasystoles, tachycardia, bradycardias, heart block, cardiac arrest

- Gastrointestinal System

  Anorexia, nausea, vomiting, diarrhoea, abdominal pain

- CNS

  Headache, dizziness, mental disturbances, visual disturbances.

- Infants and Children

  The side effects of digoxin in infants and children differ from those seen in adults in several respects. Although digoxin may produce anorexia, nausea, vomiting, diarrhea, and CNS disturbances in young patients, these are rarely the initial symptoms of overdosage.

  Rather, the earliest and most frequent manifestation of excessive dosingwith digoxin in infants and children is the appearance of cardiac arrhythmias, includingsinus bradycardia. In children, the use of digoxin may produce any arrhythmia. The most common are conduction disturbances or supraventricular tachyarrhythmias, such as atrial tachycardia (with or without block) and junctional (nodal) tachycardia. Ventricular arrhythmias are less common. Sinus bradycardia may be a sign of impending digoxin intoxication, especially in infants, even in the absence of first-degree heart block. Any arrhythmia or alteration in cardiac conduction that develops in a child taking digoxin should be assumed to be caused by digoxin, until further evaluation proves otherwise.

DILTIAZEM :-

1- ADMINISTRATION ROUTES:-

PO, NG

2- CLINICAL PHARMACOLOGY:-

Calcium channel blocker

3- ICU INDICATIONS:-

i- Rate control in atrial fibrillation

ii- Angina

4- PRESENTATION AND ADMINISTRATION:-

PO

- Immediate Release Tablets
  Dilzem 30mg tablets , Dilzem 60mg tablets
- Twice Daily Sustained Release Capsules
  Dilzem SR 90mg capsules, Dilzem SR 120mg capsules
- Once Daily Long Acting Tablets and Controlled Delivery Capsules
  Dilzem LA 180mg tablets, Dilzem LA 240mg tablets

5- DOSAGE:-

PO / NG

-In ICU it is usually appropriate to commence with 30mg 6-8 hourly and to increase asrequired to up to 360mg a day in divided doses.

-Immediate release tablets are the only formulation that can be administered via a nasogastric tube.

Note:- dosage errors with diltiazem are common due to the variety of formulations that exist. Always make sure you are administering the correct formulation

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS:-

PO

- Use Immediate Release Only

1mg/kg 8 hourly; increase to maximum of 3mg/kg 8 hourly as required

8- CONTRAINDICATIONS :-

i-Sick sinus syndrome except in the presence of a functioning Ventricularpacemaker

i- Patients with second- or third-degree AV block except in the presence ofafunctioning ventricular pacemaker

iii- Hypotension

iv- Hypersensitivity to the diltiazem

9- WARNINGS :-

- Hypotension

Decreases in blood pressure associated with Diltiazem therapy may occasionally resultin symptomatic hypotension.

- Acute Hepatic Injury

Mild elevations of transaminases with and without concomitant elevation in alkalinephosphatase and bilirubin have been observed in clinical studies. Such elevations wereusually transient and frequently resolved even with continued diltiazem treatment. Inrare instances, significant elevations in enzymes such as alkaline phosphatase, LDH,ALT, AST, and other phenomena consistent with acute hepatic injury have been noted.

10- Laboratory Tests:-

No tests in addition to routine ICU tests are indicated

11-Drug/Laboratory Test Interactions:-

None if note

12- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Due to the potential for additive effects, caution and careful titration are warranted inpatients receiving diltiazem concomitantly with other agents known to affect cardiaccontractility and/or conduction.

-Concomitant administration of diltiazem with carbamazepine has been reported to resultin elevated serum levels of carbamazepine (40-72% increase), resulting in toxicity insome cases.

- A pharmacokinetic interaction between diltiazem and cyclosporin has been observed during studies involving renal and cardiac transplant patients. In renal and cardiactransplant recipients, a reduction of cyclosporin dose ranging from 15-48% wasnecessary to maintain cyclosporin trough concentrations similar to those seen prior tothe addition of diltiazem. If these agents are to be administered concurrently,cyclosporin concentrations should be monitored, especially when diltiazem therapy isinitiated, adjusted, or discontinued.
- Coadministration of rifampin with diltiazem lowered the diltiazem plasma Concentrationsto undetectable levels. Coadministration of diltiazem with rifampin should be avoidedwhen possible, and alternative therapy considered.

13- ADVERSE REACTIONS :-

- Cardiovascular

  Oedema, angina, arrhythmia, AV block (second- or third-degree), bundle branch block,Congestive heart failure, ECG abnormalities, hypotension, palpitations, syncope,tachycardia, ventricular extrasystoles.

- Nervous System

  Headache, abnormal dreams, amnesia, depression, gait abnormality, hallucinations,insomnia, nervousness, paraesthesia, personality change, somnolence, tinnitus, tremor.

- Gastrointestinal

  Nausea, anorexia, constipation, diarrhoea, dry mouth, dysgeusia, dyspepsia, Mildelevations of SGOT, SGPT, LDH, and alkaline phosphatase, thirst, vomiting, weight increase.

- Dermatologic

  Rash, petechiae, photosensitivity, pruritus, urticaria.

DIPYRIDAMOLE:-

1- ADMINISTRATION ROUTES:-

PO, NG

2- CLINICAL PHARMACOLOGY:-

Platelet aggregation inhibitor

3- ALTERNATIVE NAMES:-

Persantin

4- ICU INDICATIONS:-

Adjunct to oral anticoagulants in circumstances where there is high risk of thrombosis.

5- PRESENTATION AND ADMINISTRATION:-

PO

- Immediate Release Tablets: 25mg tablets
- Twice Daily Sustained Release Tablets andModified Release Capsules, Persantin Perlongets 150mg Capsules

5- DOSAGE:-

PO / NG

- Usual dosage 150mg of sustained release twice a day (or equivalent daily dose ofimmediate release tablets divided and administered 6 to 8 hourly).
- Use immediaterelease tablets if administering via NGT

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS:-

PO

1-2mg/kg 6-8 hourly oral

8- CONTRAINDICATIONS :-

Hypersensitivity to dipyridamole

9- PRECAUTIONS :-

i- Coronary Artery Disease:

Dipyridamole has a vasodilatory effect and should be used with caution in patients withsevere coronary artery disease (e.g., unstable angina or recently sustained myocardialinfarction). Chest pain may be aggravated in patients with underlying coronary arterydisease who are receiving dipyridamole.

ii- Hepatic Insufficiency:

Elevations of hepatic enzymes and hepatic failure have been reported in Association with dipyridamole administration.

iii- Hypotension:

Dipyridamole should be used with caution in patients with hypotension since it Canproduce peripheral vasodilation.

10- Laboratory Tests:-

No tests in addition to standard ICU tests are required

11-Drug/Laboratory Test Interactions:-

None known

12- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

i- Adenosine:

Dipyridamole has been reported to increase the plasma levels and Cardiovascularеffects of adenosine. Adjustment of adenosine dosage may be necessary.

ii- Cholinesterase Inhibitors:

Dipyridamole may counteract the anticholinesterase effect of cholinesterase inhibitors,thereby potentially aggravating myasthenia gravis.

13- ADVERSE REACTIONS :-

- Body as a Whole
  Fatigue, malaise, myalgia
- Neurological System
  Headache
- Cardiovascular System
  Hypotension, palpitations, and tachycardia
- Respiratory System
  severe bronchospasm, larynx oedema, angioedema
- Gastrointestinal System
  Cholelithiasis, nausea, diarrhoea, vomiting, hepatitis.
- Dermatological System
  Rash, urticaria
- Haematological System
  thrombocytopaenia

DOBUTAMINE :-

1- ADMINISTRATION ROUTES:-

IV

2- CLINICAL PHARMACOLOGY:-

Dobutamine is a direct-acting inotropic agent whose primary activity results from stimulation of the beta2-receptors of the heart while producing comparatively mildchronotropic, hypertensive, arrhythmogenic, and vasodilative effects.

3- ICU INDICATIONS:-

- inotrope

4- PRESENTATION AND ADMINISTRATION:

IV

- Each 20ml vial contains 250mg of dobutamine
- Add 250mg of dobutamine (20ml) to 80ml of compatible IV fluid (i.e. 250mg in 100ml)
- Compatible with Normal saline, Glucose and sodium chloride 5% dextrose ,10% dextrose.
- Store at room temperature , Protect from light

5- DOSAGE:-

IV

Administered by infusion at rates of 2.5-20 mcg/kg/min

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS :-

IV

- 15mg/kg in 50ml of 5% dextrose or normal saline at 2.5-20mcg/kg/min (0.5-4ml/hr)1ml/hr equals 5mcg/kg/min

8- CONTRAINDICATIONS :-

i- idiopathic hypertrophic subaortic stenosis

ii- hypersensitivity to dobutamine

9- WARNINGS :-

- Increase in Heart Rate or Blood Pressure
  Dobutamine may cause a marked increase in heart rate or blood pressure, Especiallysystolic pressure.

- Ectopic Activity
  Dobutamine may precipitate or exacerbate ventricular ectopic activity, but only Rarely causes ventricular tachycardia.
- Hypersensitivity:
  Reactions suggestive of hypersensitivity associated with administration of Dobutaminein 5% dextrose injection, including skin rash, fever, eosinophilia, and bronchospasm,have been reported occasionally.

10- PRECAUTIONS :-

General

Hypovolemia should be corrected with suitable volume expanders before treatment withDobutamine

11- Laboratory Tests:-

No tests additional to routine ICU tests are indicated

12- Drug/Laboratory Test Interactions:-

None known.

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

None of note

14- ADVERSE REACTIONS : -

- Cardiovascular system
  Increased heart rate, hypotension, ventricular ectopy, atrial fibrillation, chest pain
- Respiratory system
  Shortness of breath
- Gastrointestinal system
  Nausea

DOPAMINE :-

1- ADMINISTRATION ROUTES:-

IV

2- CLINICAL PHARMACOLOGY:-

- The predominant effects of dopamine are dose-related, although it should be noted that actual response of an individual patient will largely depend on the clinical status of thepatient at the time the drug is administered.
- At low rates of infusion (0.5 to 2 mcg/kg/min) dopamine causes vasodilation that is presumed to be due to a specific agonist action on dopamine receptors (distinct fromalpha- and beta-adrenoceptors) in the renal, mesenteric, coronary and intracerebralvascular beds. At these dopamine receptors, haloperidol is an antagonist. Thevasodilation in these vascular beds is accompanied by increased glomerular filtrationrate, renal blood flow, sodium excretion and urine flow. Hypotension sometimes occurs.
  An increase in urinary output produced by dopamine is usually not associated with adecrease in osmolality of the urine.

- At intermediate rates of infusion (2-10 mcg/kg/min), dopamine acts to stimulate The beta1-adrenoceptors, resulting in improved myocardial contractility, increased SA rateand enhanced impulse conduction in the heart. There is little, if any, stimulation of thebeta2-adrenoceptors (peripheral vasodilation). Blood flow to the peripheral vascularbeds may decrease while mesenteric flow increases due to increased cardiac output.
  Total peripheral resistance (alpha effects) at low and intermediate doses is usuallyunchanged.
- At higher rates of infusion (10-20 mcg/kg/min), there is some effect on Alphaadrenoceptors,with consequent vasoconstrictor effects and a rise in blood pressure.The vasoconstrictor effects are first seen in the skeletal muscle vascular beds, but withincreasing doses, they are also evident in the renal and mesenteric vessels.
- At very high rates of infusion (above 20 mcg/kg/min), stimulation of alpha-adrenoceptorspredominates and vasoconstriction may compromise the circulation of the limbs andoverride the dopaminergic effects of dopamine, reversing renal dilation and natruresis.

3 - ICU INDICATIONS:-

Inotrope

4- PRESENTATION AND ADMINISTRATION:-

IV

- Each 5ml vial contains 200mg of dopamine
- Add 200mg of dobutamine (5ml) to 95ml of compatible IV fluid (i.e. 200mg in 100ml)
- Compatible with :Normal saline Glucose and sodium chloride 5% dextrose
- Store at room temperature ,Protect from lightPrepare solution immediately prior to use. Stable in compatible IV fluid for 24 hours atroom temperature.
- Coloured solutions indicate decomposition of dopamine and should not be used

5- DOSAGE:-

IV

Administered by infusion at rates of 0-20 mcg/kg/min

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY: -

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS:-

IV

15mg/kg in 50ml of 5% dextrose or normal saline at 0-20mcg/kg/min (0-4ml/hr)
1ml/hr equal 5mcg/kg/min

8- CONTRAINDICATIONS :-

i- Idiopathic hypertrophic subaortic stenosis
ii- Hypersensitivity to dopamine
iii-

9- WARNINGS :-

- Dopamine contains sodium metabisulfite, a sulfite that may cause allergic-type reactions including anaphylactic symptoms and life-threatening or less severe asthmaticepisodes in certain susceptible people. The overall prevalence of sulfite sensitivity in thegeneral population is unknown and probably low. Sulfite sensitivity is seen morefrequently in asthmatic than in nonasthmatic people.

10- PRECAUTIONS :-

- General
  i- Hypovolemia should be corrected with suitable volume expanders before treatment with dopamine
  ii- If an increased number of ectopic beats are observed the dose should be reduced if possible.
  iii- At lower infusion rates, if hypotension occurs, the infusion rate should be rapidlyincreased until adequate blood pressure is obtained. If hypotension persists, dopamineshould be discontinued and a more potent vasoconstrictor agent such as noradrenalineshould be added.

11- Laboratory Tests:-

No tests additional to routine ICU tests are indicated

12- Drug/Laboratory Test Interactions:-

None known.

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Patients who have been receiving monoamine oxidase (MAO) inhibitors prior to the administration of dopamine should receive substantially reduced dosage of the latter.
- Concurrent administration of low-dose dopamine and diuretic agents may produce an additive or potentiating effect on urine flow.
- Administration of phenytoin to patients receiving dopamine has been reported to lead To hypotension and bradycardia. It is suggested that in patients receiving dopamine, alternatives to phenytoin should be considered if anticonvulsant therapy is needed.

14-ADVERSE REACTIONS :-

- Cardiovascular System
  Ventricular arrhythmia (at very high doses), ectopic beats, tachycardia, anginal pain,palpitation, cardiac conduction abnormalities, widened QRS complex, bradycardia,hypotension, hypertension, vasoconstriction.
- Respiratory System
  Dyspnea.
- Gastrointestinal System
  Nausea, vomiting.
- Central Nervous System
  Headache, anxiety.
- Other
  Gangrene of the extremities has occurred when high doses were administered For prolonged periods or in patients with occlusive vascular disease receiving low doses of dopamine.

DOXAPRAM :-

1- ADMINISTRATION ROUTES:-

- IV

2- CLINICAL PHARMACOLOGY:-

- Doxapram hydrochloride produces respiratory stimulation mediated through The peripheral carotid chemoreceptors. As the dosage level is increased, the Centralrespiratory centers in the medulla are stimulated with stimulation of Other parts of the brain and spinal cord.

- The onset of respiratory stimulation following the recommended single Intravenous injection of doxapram hydrochloride usually occurs in 20 to 40 seconds with peak effect at 1 to 2 minutes. The duration of effect may vary from 5 to 12 minutes.
- The respiratory stimulant action is manifested by an increase in tidal volume Associated with a slight increase in respiratory rate.
- Although opiate-induced respiratory depression is antagonized by doxapram, The analgesic effect is not affected.

3- ALTERNATIVE NAMES:-

DOPRAM INJECTION 5mL

Each 1 mL contains: 20 mg Doxapram hydrochloride

4- INDICATIONS:-

i- Post anesthesia

- When the possibility of airway obstruction and/or hypoxia have been eliminated, doxapram may be used to stimulate respiration in patients with drug-induced anesthesia respiratory depression or apnea other than that due to muscle relaxantdrugs.
- To pharmacologically stimulate deep breathing in the postoperative patient. (Aquantitative method of assessing oxygenation, such as pulse oximetry, is recommended.)

ii-Drug-Induced Central Nervous System Depression

- Exercising care to prevent vomiting and aspiration, doxapram may be used to stimulaterespiration, hasten arousal, and to encourage the return of laryngopharyngeal reflexes inpatients with mild to moderate respiratory and CNS depression due to drug overdosage.

iii- Chronic Pulmonary Disease Associated with Acute Hypercapnia

- Doxapram is indicated as a temporary measure in hospitalized patients with Acuterespiratory insufficiency superimposed on chronic obstructive pulmonary disease. Itsuseshould be for a short period of time as anaid in the prevention

of elevation of arterial CO2 tension during the administration ofoxygen.

Note:-It should not be used in conjunction with mechanical ventilation.

5 - PRESENTATION AND ADMINISTRATION:-

- DOPRAM20mg Injection
- NOT FOR USE IN NEONATES

6-DOSAGE:-

a- In Post anesthetic Use

Dosage for post anesthetic use—I.V. and infusion.

I.V. Administration	Recommended Dosage mg/kg	Maximum dose per single injection mg/kg	Maximum total dose mg/kg
Single Injection	0.5-1	1.5	1.5
Repeat Injections (5 min. intervals)	0.5-1	1.5	2
Infusion	0.5-1	-	4
Note :- Dose not to exceed 3 grams/24 hours.			

b- By I.V. Injection

The recommended dose for I.V. administration is 0.5 – 1 mg/kg for a single injection and at 5-minute intervals. Careful observation of the patient during administration and for some time subsequently are advisable. The maximum total dosage by I.V. injection is 2 mg/kg.

c- By Infusion

The solution is prepared by adding 250 mg of doxapram (12.5 mL) to 250 mL of dextrose 5% or 10% in water or normal saline solution. The infusion is initiated at a rate of approximately 5 mg/minute until a satisfactory respiratory response is observed, and maintained at a rate of 1 to 3 mg/minute. The rate of infusion should be adjusted to sustain the desired level of respiratory stimulation with a minimum of side effects. The maximum total dosage by infusion is 4 mg/kg, or approximately 300 mg for the average adult.

d- In the Management of Drug-Induced CNS Depression

Table II. Dosage for drug -induced CNS depression.

Level of Depression	**Method One** priming dose single /repeat IV injection mg/ Kg	**METHOD TWO** Rate of Intermittent I.V. Infusion mg/ Kg/h
Mild	1	1-2
Moderate	2	2-3
-Mild Depression - Class 0: Asleep, but can be aroused and can answer questions. - Class 1: Comatose, will withdraw from painful stimuli, reflexes intact. **- Moderate Depression** - Class 2: Comatose, will not withdraw from painful stimuli, reflexes intact. - Class 3: Comatose, reflexes absent, no depression of circulation or respiration.		

i- Method One:-

Using Single and/or Repeat Single I.V. Injections

a. Give priming dose of 2 mg/kg body weight and repeat in 5 minutes. The priming dose for moderate depression is 2 mg/kg and the priming dose for mild depression is 1mg/kg.

b. Repeat same dose q 1 to 2h until patient wakens. Watch for relapse into unconsciousness or development of respiratory depression, since DOPRAM does not affect the metabolism of CNS-depressant drugs.

c. If relapse occurs, resume injections q 1 to 2h until arousal is sustained, or total maximum daily dose (3 grams) is given. After maximum dose has been given (3 grams), allow patient to sleep until 24 hours have elapsed from first injection of DOPRAM, using assisted or automatic respiration if necessary.

d- Repeat procedure the following day until patient breathes spontaneously and sustains desired level of consciousness, or until maximum dosage (3 grams) is given.

e- Repetitive doses should be administered only to patients who have shown response to the initial dose.

f- Failure to respond appropriately indicates the need for neurologic evaluation for a possible central nervous system source of sustained coma.

ii-Method Two :-

By Intermittent I.V. Infusion

a- Give priming dose as in Method One.

b- If patient wakens, watch for relapse; if no response, continue general supportive treatment for 1 to 2 hours and repeat priming dose of DOPRAM. If some respiratory stimulation occurs, prepare I.V. infusion by adding 250 mg of DOPRAM (12.5 mL) to 250 mL of saline or dextrose solution. Deliver at rate of 1 to 3 mg/min (60 to 180 mL/hr) according to size of patient and depth of coma. Discontinue DOPRAM if patient begins to waken or at end of 2 hours.

c- Continue supportive treatment for ½ to 2 hours and repeat Step b.
d- Do not exceed 3 grams/day.

Chronic Obstructive Pulmonary Disease Associated with Acute Hypercapnia

a- One vial of doxapram (400 mg) should be mixed with 180 mL of dextrose 5% or 10% or normal saline solution (concentration of 2 mg/mL). The infusion should be Started at 1 to 2 mg/minute (½ to 1 mL/minute); if indicated, increase to a maximum of 3 mg/minute. Arterial blood gases should be determined prior to the onset of doxapram's administration and at least every half hour during the two hours of infusion to insure against the insidious development of Co2 retention and acidosis

Alteration of oxygen concentration or flow rate may necessitate adjustment in the rate of doxapram infusion.

b- Predictable blood gas patterns are more readily established with a continuous infusion of doxapram. If the blood gases show evidence of deterioration, the infusion of doxapram should be discontinued.

c- Additional infusions beyond the single maximum two hours ,administration period are not recommended .

- Parenteral drug products should be inspected visually for particulate matter and discoloration prior to administration, whenever solution and container permit.
- Diluent Compatibility ,Doxapram hydrochloride is compatible with 5% and 10% dextrose and normal saline.
- Store at 20°-25°C

7-USAGE IN PAEDIATRICS:-

- Safety and effectiveness in pediatric patients below the age of 12 years have not been established. This product contains benzyl alcohol as a preservative.
- Benzyl alcohol, a component of this product, has been associated with serious adverse events and death, particularly in pediatric patients. The "gasping syndrome", (characterized by central nervous system depression, metabolic acidosis, respirations, and high levels of benzyl alcohol and its metabolites found in the blood and urine) has been associated with benzyl alcohol dosages >99 mg/kg/day in neonates and low-birth-weight neonates.
- Additional symptoms may include gradual neurological deterioration, seizures, intracranial hemorrhage, hematologic abnormalities, skin breakdown, hepatic and renal failure, hypotension, bradycardia, and cardiovascular collapse. Although normal therapeutic doses of this product deliver amounts of benzyl alcohol that are substantially lower than those reported in association with the "gasping syndrome", the minimum amount of benzyl alcohol at which toxicity may occur is not known.

Premature and low birth-weight infants, as well as patients receiving high dosages, may be more likely to develop toxicity. Practitioners administering this and other medications containing benzylalcohol should consider the combined daily metabolic load of benzyl alcohol from allsources.

- Premature neonates given doxapram have developed hypertension, irritability , jitteriness, hyperglycemia, glucosuria, abdominal distension, increased gastric residuals, vomiting, bloody stools, necrotizing enterocolitis, erratic limb movements, excessive crying, disturbed sleep, premature eruption of teeth, and QT prolongation

that has resulted inheart block.
In premature neonates with risk factors such as a previous seizure, perinatal asphyxia, or intracerebral hemorrhage, seizures have occurred.
In many instances, doxapram was administered following administration of xanthine derivatives such as caffeine, aminophylline or theophylline.

8- CONTRAINDICATIONS:-

Doxapram is contraindicated in patients with

- known hypersensitivity to the drug or any of the injection components.
- epilepsy or other convulsive disorders.
- proven or suspected pulmonary embolism.
- mechanical disorders of ventilation such as mechanical obstruction, muscle paresis (including neuromuscular blockade), flail chest, pneumothorax, acute bronchial asthma, pulmonary fibrosis, or other conditions resulting in restriction of the chest wall, muscles of respiration,or alveolar expansion.
- head injury, cerebral vascular accident, or cerebral edema, and in thosewith significant cardiovascular impairment, uncompensated heart failure, severe coronary artery disease, or severe hypertension, including that associated with hyperthyroidism or pheochromocytoma.

9- WARNINGS :-

- Doxapram should not be used in conjunction with mechanical ventilation.
- The amount of benzyl alcohol from medications is usually considered negligible compared to that received in flush solutions containing benzyl alcohol.
- Administration of high dosages of medications containing this preservative must take into account the total amount of benzyl alcohol administered. The amount of benzyl alcohol at which toxicity may occur is not known. If the patient requires more than the recommended dosages or other medications containing this preservative, the practitioner must consider the daily metabolic load of benzyl alcohol from these combined sources .

- In Postanesthetic Use

a- Doxapram is neither an antagonist to muscle relaxant drugs nor a specific narcotic antagonist. More specific tests (eg, peripheral nerve stimulation, airway pressures, head lift, pulse oximetry, and end-tidal carbon dioxide) to assess adequacy of ventilation are recommended before administering doxapram.

b- Doxapram should be administered with great care and only under careful supervision to patients with hypermetabolic states such as hyperthyroidism or pheochromocytoma.

c- Since narcosis may recur after stimulation with doxapram, care should be taken to maintain close observation until the patient has been fully alert for ½ to 1 hour.

d- In patients who have received general anesthesia utilizing a volatile agent known to sensitize the myocardium to catecholamines, administration of doxapram should be delayed until the volatile agent has been excreted in order to lessen the potential for arrhythmias, including ventricular tachycardia and ventricular fibrillation .

- In Drug-Induced CNS and Respiratory Depression

Doxapram alone may not stimulate adequate spontaneous breathing or provide sufficient arousal in patients who are *severely* depressed either due to respiratory failure or to CNS depressant drugs, but may be used as an adjunct to established supportive measures and resuscitative techniques.

In Chronic Obstructive Pulmonary Disease

Because of the associated increased work of breathing, do not increase the rate of infusion of doxapram in severely ill patients in an attempt to lower pCO2.

10-PRECAUTIONS :-

General

a- An adequate airway is essential and airway protection should be considered since doxapram may stimulate vomiting.

b- Recommended dosages of doxapram should be employed and maximum total dosages should not be exceeded. In order to avoid side effects, it is advisable to use the minimum effective dosage.

c- Monitoring of the pressure, pulse rate, and deep tendon reflexes is recommended to prevent overdosage.

d- Vascular extravasation or use of a single injection site over an extended period should be avoided since either may lead to thrombophlebitis or local skin irritation.

e- Rapid infusion may result in hemolysis.

f- Lowered pCO2 induced by hyperventilation produces cerebral vasoconstriction and slowing of the cerebral circulation. This should be taken into consideration on an individual basis. In certain patients a pressor effect of doxapram on the pulmonary circulation may result in a fall of the arterial pO2 probably due to a worsening of ventilation perfusion-matching in the lungs despite an overall improvement in alveolar ventilation and a fall in pCO2. Patients should be carefully supervised taking into account available blood gas measurements.

g- There is a risk that doxapram will produce adverse effects (including seizures) due to general central nervous system stimulation. Muscle involvement may range from fasciculation to spasticity. Anticonvulsants such as intravenous short-acting barbiturates, along with oxygen and resuscitative equipment should be readily available to manage overdosage manifested by excessive central nervous system stimulation.

Slow administration of the drug and careful observation of the patient during administration and for some time subsequently are advisable. These precautions are to assure that the protective reflexes have been restored and to prevent possible post-hyperventilation or hypoventilation.

h- Doxapram should be administered cautiously to patients receiving sympathomimetic or monoamine oxidase inhibiting drugs, since an additive pressor effect may occur.

i- Blood pressure increases are generally modest but significant increases have been noted in some patients. Because of this, doxapram is not recommended for use in patients with severe hypertension (see CONTRAINDICATIONS).

j- Cardiovascular effects may include various dysrhythmias. Patients receiving doxapram should be monitored for disturbance of their cardiac rhythm.

k- If sudden hypotension or dyspnea develops, doxapram should be stopped.

l- Doxapram should be administered with caution to patients with significantly

impaired hepatic or renal function as a reduction in the rate of metabolism or excretion of metabolites may alter the response.

In Postanesthetic Use

a. The same consideration to pre-existing disease states should be exercised as in non anesthetized individuals. Covering use in hypertension, asthma, disturbances of respiratory mechanics including air way obstruction, CNS disorders including increased cerebrospinal fluid pressure, convulsive disorders, acute agitation, and profound metabolic disorders.

b. See PRECAUTIONS, Drug Interactions.

In Chronic Obstructive Pulmonary Disease

a. Arrhythmias seen in some patients in acute respiratory failure secondary to chronic obstructive pulmonary disease are probably the result of hypoxia. Doxapram should be used with caution in these patients.

b. Arterial blood gases should be drawn prior to the initiation of doxapram infusion and oxygen administration, then at least every ½ hour during the infusion period to prevent development of CO2 retention and acidosis in patients with chronic obstructive pulmonary disease with acute hypercapnia. Doxapram administration does not diminish the need for careful monitoring of the patient or the need for supplemental oxygen in patients with acute respiratory failure. Doxapram should be stopped if the arterial blood gases deteriorate, and mechanical ventilation should be initiated.

11- Drug Interactions:-

- Administration of doxapram to patients who are receiving sympathomimetic or monoamine oxidase inhibiting drugs may result in an additive pressor effect .
- In patients who have received neuromuscular blocking agents, doxapram may temporarily mask the residual effects of these drugs.
- In patients who have received general anesthesia utilizing a volatile agent known to sensitize the myocardium to catecholamines, administration of doxapram should be delayed until the volatile agent has been excreted in order to lessen the potential for arrhythmias, including ventricular tachycardia and ventricular fibrillation .
- There may be an interaction between doxapram and aminophylline and between theophylline manifested by increased skeletal muscle activity, agitation, and hyperactivity.

- Carcinogenesis, Mutagenesis, Impairment of Fertility

No carcinogenic or mutagenic studies have been performed using doxapram. Doxapram did not adversely affect the breeding performance of rats.

-Pregnancy

- Pregnancy Category B

Reproduction studies have been performed in rats at doses up to 1.6 times the human dose and have revealed no evidence of impaired fertility or harm to the fetus due to doxapram.

There are, however, no adequate and well-controlled studies in pregnant

women. Because the animals in the reproduction studies were dosed by the IM and oral routes and animal reproduction studies, in general, are not always predictive of human response, this drug should be used during pregnancy only if clearly needed.

Nursing Mothers

It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk, caution should be exercised when doxapram hydrochloride is administered to a nursing woman.

12- ADVERSE REACTIONS :-

Adverse reactions reported coincident with the administration of DOPRAM (doxapram hydrochloride, USP) include:

1- Central and Autonomic Nervous Systems

Pyrexia, flushing, sweating; pruritus and paresthesia, such as a feeling of warmth,burning, or hot sensation, especially in the area of genitalia and perineum;apprehension, disorientation, pupillary dilatation, hallucinations, headache, dizziness,hyperactivity, involuntary movements, muscle spasticity, muscle fasciculations,increased deep tendon reflexes, clonus, bilateral Babinski, and convulsions.

2- Respiratory

Dyspnea, cough, hyperventilation, tachypnea, laryngospasm, bronchospasm, hiccough, and rebound hypoventilation.

3- Cardiovascular

Phlebitis, variations in heart rate, lowered T-waves, arrhythmias (including ventricular tachycardia and ventricular fibrillation), chest pain, tightness in chest. Amild to moderate increase in blood pressure is commonly noted and may be of concern in patients with severe cardiovascular diseases.

4- Gastrointestinal

Nausea, vomiting, diarrhea, desire to defecate.

5- Genitourinary

Stimulation of urinary bladder with spontaneous voiding; urinary retention. Elevation of BUN and albuminuria.

6- Hemic and Lymphatic

Hemolysis with rapid infusion. A decrease in hemoglobin, hematocrit, or red blood cell count has been observed in postoperative patients. In the presence of pre-existing leukopenia, a further decrease in WBC has been observed following anesthesia and treatment with doxapram hydrochloride.

13- OVERDOSAGE

Signs and Symptoms

- Symptoms of overdosage are extensions of the pharmacologic effects of the drug. Excessivepressor effect, such as hypertension, tachycardia, skeletal muscle hyperactivity, and enhanced deep tendon reflexes may be early signs of overdosage.

-Therefore, the blood pressure, pulse rate, and deep tendon reflexes should be evaluated periodically and the dosage or infusion rate adjusted accordingly.

Other effects may include agitation, confusion, sweating, cough, and dyspnea. Convulsive seizures are unlikely at recommended dosages. In unanesthetized animals, the convulsant dose is 70 times greater than the respiratory stimulant dose.

- Except for management of chronic obstructive pulmonary disease associated with Acute hypercapnia, the maximum recommended dosage is 3 GRAMS/24 HOURS.

Management

- There is no specific antidote for doxapram. Management should be symptomatic. Anticonvulsants, along with oxygen and resuscitative equipment should be readily available to manage overdosage manifested by excessive central nervous system stimulation. Slow administration of the drug and careful observation of the patient during administration and for some time subsequently are advisable. These precautions are to assure that the protective reflexes have been restored and to prevent possible post hyperventilation or hypoventilation.
- There is no evidence that doxapram is dialyzable; further, the half-life of doxapram makes it unlikely that dialysis would be appropriate in managing overdose with this drug.

ENOXAPARIN :-

1- ADMINISTRATION ROUTES:-

CLEXANE SC

2- CLINICAL PHARMACOLOGY:-

Low molecular weight heparin

3- ICU INDICATIONS:-

i- Therapeutic anticoagulation

ii- DVT prophylaxis

4- PRESENTATION AND ADMINISTRATION:-

SC

- Pre-mixed syringes 20mg/0.2ml, 40mg/0.4ml, 100mg/ml
- Do not remove air bubble from pre-mixed syringe prior to injection
- Inject at 90 degrees to the skin on the lower abdomen. Alternate between the left andright anterolateral abdominal wall
- Do not rub injection site after injection

5- DOSAGE:-

SC

i- DVT prophylaxis

40mg sc daily (**ALWAYS** chart this at night. As most procedures happen during daylighthours, prescribing enoxaparin at night reduces the risk of procedural bleedingsecondary to enoxaparin)

ii- Therapeutic enoxaparin

The standard treatment doses of enoxaparin (weight adjusted) are either 1mg/kg twicedaily or 1.5mg/kg once dailyEnoxaparin dosing in extremes of bodyweightThe dose of enoxaparin does not need to be adjusted in the morbidly obese (BMI >35,or greater than 150kg), or those with a BMI <20 (underweight). These patients shouldbe dosed on a mg/kg basis in the same way as patients of normal bodyweight, withadjustment for renal impairment if needed. There is evidence that twice daily dosing is safer for patients with BMI >35 or weight >150kg.

People at extremes of bodyweight (BMI <20 or >35) should have their Anti Xa levelchecked after 48 hours of dosing of enoxaparin, and the dose of enoxaparin adjusted asabove.

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]

<30 - 0.66mg/kg 12 hourly

30-59 - 0.8mg/kg 12 hourly

Note: the above doses are for therapeutic clexane; the recommended dose for DVT prophylaxis in patients with a GFR of <30 is 20mg daily

- Dose in renal replacement therapy

Use systemic heparinisation in ICU in these patients

7-DOSAGE IN PAEDIATRICS:-

i- Therapeutic Enoxaparin

1mg/kg 12 hourly sc

ii- Prophylactic Enoxaparin

<2 months: 0.75mg/kg 12 hourly

2 months – 18 years: 0.5mg/kg 12 hourly

8- CONTRAINDICATIONS :-

i- Hypersensitivity to enoxaparin
ii- Active bleeding
iii- Presence of an external ventricular drain

9- WARNINGS :-

i- Bleeding Risk

Every patient being considered for enoxaparin therapy should be assessed for their risk of bleeding. This assessment should be documented in the patient's notes. There is an increased risk of any bleeding with enoxaparin use in patients who: are elderly (>65yo), have a BMI <20, have renal impairment, require a prolonged period of treatment, take concomitant clopidogrel (an 8-fold increased risk of major bleeding), aspirin or NSAID (3-4fold increased risk), ave had a previous upper GI bleed, have moderate hypertension (BP 140-180 systolic, 90-110), have undiagnosed iron deficiency anaemia (in non-menstruating woman).

10-PRECAUTIONS :-

General

Many ICU procedures require reversal of anticoagulation. As enoxaparin is a not readily reversed, therapeutic systemic heparinisation may be a more appropriate choice in the many ICU patients

11- Laboratory Tests:-

- Routine Anti Xa monitoring is **not** recommended.
- Patients requiring Anti Xa monitoring

Measuring peak Anti Xa activity is recommended for patients on therapeutic doses of clexane in the following situations:-

. patients with moderate renal impairment (CrCl <60ml/min)
. patients who weigh <50kg
. patients who are morbidly obese (BMI >35)
. pregnant patients
. patients receiving treatment dose enoxaparin for longer than 14 days
. patients with changing renal function
. have increased risk of bleeding

- When to monitor Anti Xa

Peak Anti-Xa concentration yields the best correlation with clinical effect, and risk of bleeding.

- Anti Xa monitoring should only occur when enoxaparin is at steady state, Which occurs after about 48 hours (5 half lives). It is not recommended that Xa levels are taken prior to this, as they are unable to be interpreted.
- Patients receiving enoxaparin for less than 48 hours do not need Anti Xa monitoring.
- Peak Anti Xa should be taken 4 hours after the dose of enoxaparin is given.

Trough measurements

- Measuring trough Anti Xa activity routinely is not recommended as the correlation between bleeding risk and trough Anti Xa has not been clearly established.

Trough Anti Xa concentrations should however be monitored at the end of the dosing interval for patients with severe renal impairment (GFR <30ml/min) if the decision to use enoxaparin has been made. These patients should also have peak Anti-Xa levels taken. For twice daily dosing, the sample should be taken 12 hours after a dose, immediately preceding the next dose, and should be ≤ 0.5IU/ ml.If the trough level is > 0.5 IU/ml, the patient should be changed to once daily dosing of enoxaparin, using the above nomogram. For once daily dosing, the sample should be taken 20 hours after a dose, and should be ≤ 0.4 IU/ml.

- **Therapeutic range**

. The therapeutic peak Anti Xa range for treatment dose enoxaparin is 0.5−1.2 IU/ ml for twice daily dosing, or 1−2 IU/ml for once daily dosing. The dose should be adjusted using the following nomogram:

Enoxaparin dose adjustment after Peak Anti Xa monitoring (TWICE daily dosing only)

Anti Xa level	**Hold next dose**	**Dose change**	**Next Peak Anti Xa level(Always take level 4 hoursafter dose)**
<0.25	No	Increase by 50%	48 hours
0.25- 0.49	No	Increase by 25%	48 hours
0.5 - 1.2	No	No	1 week
1.21 - 1.5	No	Decrease by 25%	48 hours
1.51 – 2	For 3 hours	Decrease by 30%	48 hours after next dose
>2	Until Anti Xa <0.5 IU/ml (check every 6 hours)	Decrease by 50%	48 hours after next dose Consider changing to UFH

Note: These nomograms are only valid if the patient is not bleeding and the renal function is stable.

12- Drug/Laboratory Test Interactions :-

None noted.

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Increased risk of bleeding when combined with other anti-platelet and Anticoagulantagents

14- ADVERSE REACTIONS :-

- Body as a Whole:
  Bleeding, anaphylaxis, fever
- Cardiovascular System
  Peripheral oedema,
- Haematological System
  Anaemia, thrombocytopaenia, HITTS
- Gastrointestinal System
  GI upset, elevated LFTs
- Local
  haematoma (at injection site), skin necrosis

EPHEDRINE :-

1- ADMINISTRATION ROUTES:-

IV

2- CLINICAL PHARMACOLOGY:-

- Ephedrine stimulates both alpha and beta receptors and its peripheral actions

are due partly to norepinephrine release and partly to direct effect on receptors.
- Ephedrine may deplete norepinephrine stores in sympathetic nerve endings, so that tachyphylaxis to cardiac and pressor effects of the drug may develop.

3- ICU INDICATIONS:-

Drug-induced hypotension (particularly in association with bradycardia)

Note: used commonly in Anaesthesia but of limited utility in the ICU setting

4 - PRESENTATION AND ADMINISTRATION:-

IV

- Vial contains 50mg in 1ml
- Dilute 50mg to a total of 10ml using normal saline (giving a concentration of 3mg/ml)
- Store at room temperature
- Protect from light
- Compatible with Normal saline 5% dextrose 10% dextrose .

5- DOSAGE:-

IV

Administer by direct IV injection of 3-9mg and repeat as required

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS:-

IV

0.25-1mg/kg (max 5mg/dose)

8- CONTRAINDICATIONS :-

Hypersensitivity to ephedrine

9- WARNINGS :-

- Ephedrine may cause hypertension resulting in intracranial haemorrhage.
- Ephedrine may induce anginal pain in patients with coronary insufficiency or ischemic heart disease.
- The drug also may induce potentially fatal arrhythmias in patients with organic heart disease or who are receiving drugs that sensitize the myocardium

10- PRECAUTIONS :-

General

Ephedrine should be used cautiously in patients with hyperthyroidism, hypertension ,heart disease (including coronary insufficiency, angina pectoris and patients receiving digitalis), cardiac arrhythmias, diabetes or unstable vasomotor system.

11- Laboratory Tests:-

No tests in addition to routine ICU tests are required.

12- Drug/Laboratory Test Interactions:-

None known

13 - IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Ephedrine should not be administered concomitantly with other sympathomimetic drugsbecause of possible additive effects and increased toxicity.
- Alpha-adrenergic blocking agents may reduce the vasopressor response to ephedrine by causing vasodilation.Beta-adrenergic blocking drugs may block the cardiac and bronchodilating effects ofephedrine.
- Ephedrine also should be used cautiously with other drugs (e.g., digitalis glycosides) that sensitize the myocardium to the actions of sympathomimetic agents.

14- ADVERSE REACTIONS :-

- Cardiovascular system
  Hypertension, tachyarrhythmias, palpitations
- Neurological system
  headache, restlessness, anxiety, tension, tremor, weakness, dizziness, confusion,delirium hallucinations
- Gastrointestinal system
  nausea or vomiting

ESMOLOL :-

1- ADMINISTRATION ROUTES:-

IV

2- CLINICAL PHARMACOLOGY:-

Esmolol hydrochloride is a beta1-selective (cardioselective) adrenergic Receptor blocking agent with a very short duration of action (elimination half-life is approximately 9 minutes).

3- ALTERNATIVE NAMES:-

Breviblock

4- ICU INDICATIONS:-

i- Hypertension
ii- Tachydysrhythmia

Note: esmolol is primarily used where there is concern that beta blockade will not be well tolerated because it is very short acting so that if an adverse reaction occurs the drug will wear off rapidly.

5- PRESENTATION AND ADMINISTRATION:-

IV

- 100mg in 10ml vial (10mg/ml)
- Use 10mg/ml solution undiluted for loading dose and infusion
- Store at room temperature.
- Freezing does not adversely affect the product, but exposure to elevated Temperatures should be avoided.
- Protect from light
- Esmolol loading dose should be administered by a doctor.

6- DOSAGE:-

IV

- Loading dose: 500mcg/kg over one minute (eg 70kg patient = 3.5ml of 10mg/ml)
- Maintenance dose: 0-200mcg/kg/minute

Note:- due to its high cost and the fact that cheaper alternatives exist, esmolol is rarely given by infusion

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8-DOSAGE IN PAEDIATRICS :-

IV

- Loading dose: 500mcg/kg over one minute
- Maintenance dose: 0-300mcg/kg/minute

9- CONTRAINDICATIONS :-

i- Sinus bradycardia,
ii- Heart block greater than first degree,
iii- Cardiogenic shock
iv- Overt heart failure

10- Risk of death in unstable patients :-

Despite the rapid onset and offset of esmolol effects, several cases of death have been reported in complex clinical states where esmolol was being used

to control ventricularrate.

11- Bronchospastic Diseases :-

Because of its relative beta1 selectivity and titratability, esmolol may be used withcaution in patients with bronchospastic diseases. However, since beta1 selectivity is notabsolute, esmolol should be carefully titrated to obtain the lowest possible effectivedose. In the event of bronchospasm, the infusion should be terminated immediately; abeta2 stimulating agent may be administered if conditions warrant but should be used with particular caution as patients already have rapid ventricular rates.

12- Laboratory Tests:-

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions:-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

- Caution should be exercised when considering the use of esmolol and Verapamil in patients with depressed myocardial function. Fatal cardiac arrests have occurred in patients receiving both drugs.
- Esmolol should not be used to control supraventricular tachycardia in the presence of agents which are vasoconstrictive and inotropic such as dopamine, epinephrine, and norepinephrine because of the danger of blocking cardiac contractility when systemic vascular resistance is high.

15- ADVERSE REACTIONS :-

- Cardiovascular System
  Symptomatic hypotension, pallor, flushing, bradycardia (heart rate less than 50 beats per minute), chest pain, syncope, pulmonary oedema and heart block.
- Central Nervous System
  Dizziness, somnolence, confusion, headache, and agitation
- Respiratory System
  Bronchospasm, wheezing, and dyspnoea.
- Gastrointestinal System
  Nausea, vomiting, dyspepsia, constipation, dry mouth, and abdominal discomfort
- Skin (infusion site)
  Infusion site reactions including inflammation and induration

FENTANYL :-

1- ADMINISTRATION ROUTES:-

IV

2- CLINICAL PHARMACOLOGY:-

Fentanyl citrate is a narcotic analgesic. A dose of 100 mcg is approximately Equivalentin analgesic activity to 10 mg of morphine.

3- ICU INDICATIONS:-

i- Opioid analgesia
ii- Induction of anaesthesia

4- PRESENTATION AND ADMINISTRATION:

- IV
  100mcg in 2ml (50mcg/ml), 500mcg in 10ml (50mcg/ml)
  Compatible with Normal saline , 5% glucose
  Store at room temperature
- Transdermal
  12.5mcg/hour, 25mcg/hour, 50mcg/hour, 75mcg/hour, and 100mcg/hour patches
  Apply to clean, dry, non hairy, non-irritated skin of the torso or upper arm.
  Rotate application site.
  Wear patch continuously for 72 hours.

5- DOSAGE:-

- IV
  Infusion doses are typically 0-100mcg/hr
  Doses as part of induction of anaesthesia are typically 50-200mcg ,
  in ICU patients;much higher doses are occasionally required.
- Transdermal
  Usually commence with 25mcg/hour .

5- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  <10 - 50% of normal dose
  10-20 - 75% of normal dose
  >20-50 - dose as in normal renal function
- Dose in renal replacement therapy
  CAPD 50% of normal dose
  HD 50% of normal dose

Note: although these dosages provided here are indicative, fentanyl is titrated to effect and the required dose to achieve the desired effect is the correct dose (irrespective ofthe renal function)

6 -DOSAGE IN PAEDIATRICS:-

- IV
  1-10 mcg/kg; infusion 5-10 mcg/kg/hr
- For infusion in paediatrics
  <10kg 100mcg/kg in 50ml 5% dextrose at 1-2ml/hr
  >10kg 50mcg/ml at 0.04-0.08ml/kg/hr

7- CONTRAINDICATIONS :-

Hypersensitivity to fentanyl

8- WARNINGS :-

May cause muscle rigidity, particularly involving the muscles of respiration, when givenrapidly.

9- PRECAUTIONS :-

General
Fentanyl may produce bradycardias

10- Laboratory Tests :-

No tests additional to routine ICU tests are required

11- Drug/Laboratory Test Interactions:-

None of note

12- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Other CNS depressant drugs (e.g., barbiturates, tranquilizers, narcotics and Generalanaesthetics) will have additive or potentiating effects with fentanyl

13- ADVERSE REACTIONS :-

- Body as a Whole
  Anaphylaxis, pruritus, urticaria
- Cardiovascular System
  hypertension, hypotension, and bradycardia
- Respiratory System
  Laryngospasm, respiratory depression, and apnea
- Gastrointestinal System
  Nausea, emesis,
- Neurological System
  Dizziness, blurred vision, extrapyramidal symptoms (dystonia, akathisia and Oculogyriccrisis)

FLUMAZENIL :-

1- ADMINISTRATION ROUTES:-

IV

2- CLINICAL PHARMACOLOGY:-

Flumazenil, an imidazobenzodiazepine derivative, antagonizes the actions of benzodiazepines on the central nervous system. Flumazenil competitively inhibits theactivity at the benzodiazepine recognition site on the GABA/benzodiazepine receptorcomplex.

3 - ALTERNATIVE NAMES:-

Anexate

4- ICU INDICATIONS:-

Reversal of the sedative effects of benzodiazepines

5- PRESENTATION AND ADMINISTRATION:-

IV

- 0.5mg/5ml of solution
- Inject undiluted solution over 15 seconds preferably through a freely running
- IV infusionof compatible IV fluid and into a large vein.
- For continuous infusion add 0.5mg to 50ml or 1mg to 100ml of compatible IVFluid(concentration 0.01mg/ml).
- Infuse at a rate of 0.1-0.4mg/hr (10-40ml/hr) and titrate toeffect.
- Compatible with 0.9% sodium chloride 5% glucose .

6- DOSAGE:-

IV

Initially 0.2mg, followed by 0.1mg every 60 seconds as required to a maximum of 1mg

Note: in hepatic impairment initial dose remains the same but subsequent doses Should be reduced in size or frequency

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

IV

5mcg/kg every 60 seconds to a maximum total of 40mcg/kg then 2-10mcg/kg/hr

9- CONTRAINDICATIONS:-

- hypersensitivity to flumazenil or benzodiazepines
- benzodiazepine dependence

10- WARNINGS :-

- The use of flumazenil has been associated with sccurrence of seizures . That rae most frequent with patients who have been on benzodiazepine for long term sedation or overdose

- Flumazenil should be used with caution in the ICU because of the increased risk Of unrecognized benzodiazepine dependence in such settings.
- Flumazenil may produce convulsions in patients physically dependent on benzodiazepines.

11- PRECAUTIONS :-

General

- Risk of Seizures

The reversal of benzodiazepine effects may be associated with the onset of

seizures incertain high-risk populations.

- Possible risk factors for seizures include:
  concurrent majorsedative-hypnotic drug withdrawal, recent therapy with repeated doses of parenteralbenzodiazepines, myoclonic jerking or seizure activity prior to flumazenil administration
- in overdose cases, or concurrent cyclic anti-depressant poisoning
  HypoventilationPatients who have received flumazenil for the reversal of benzodiazepine effects (afterconscious sedation or general anaesthesia) should be monitored for resedation,respiratory depression, or other residual benzodiazepine effects for an appropriateperiod (up to 120 minutes) based on the dose and duration of effect of thebenzodiazepine employed.

12- Laboratory Tests:-

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions :-

None noted.

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Particular caution is necessary when using flumazenil in cases of mixed drug overdosage since the toxic effects (such as convulsions and cardiac dysrhythmias) ofother drugs taken in overdose (especially cyclic antidepressants) may emerge with the reversal of the benzodiazepine effect by flumazenil.

15-ADVERSE REACTIONS :-

- Body as a Whole
  Fatigue (asthenia, malaise), Headache, Injection Site Pain, Injection Site Reaction(thrombophlebitis, skin abnormality, rash).
- Cardiovascular System
  Cutaneous vasodilation (sweating, flushing, hot flushes).
- Digestive System
  Nausea and Vomiting.
- Nervous System
  Agitation (anxiety, nervousness, dry mouth, tremor, palpitations, insomnia, dyspnea,hyperventilation), dizziness (vertigo, ataxia), emotional lability (crying abnormal,depersonalization, euphoria, increased tears, depression, dysphoria, paranoia).
- Special Senses
  Abnormal Vision (visual field defect, diplopia), Paraesthesia (sensation abnormal, hypoesthesia).

FRUSEMIDE :-

1 - ADMINISTRATION ROUTES:-

PO, IV

2- CLINICAL PHARMACOLOGY:-

Frusemide is a potent diuretic that inhibits the absorption of sodium and chloride in theproximal and distal tubules and the loop of Henle.

3- ICU INDICATIONS:-

i-Fluid retention manifesting as pulmonary or peripheral oedema

ii- Hyperkalaemia

4- PRESENTATION AND ADMINISTRATION:-

PO

- Tablets

Lasix 40mg tablets , lafurex 20mg tablets

IV

- IV formulations available are: Lasix injection 40mg/2ml solution, Lasix injection 20mg/2ml Administer doses of up to 80mg by slow IV injection over 2-5 Minutes For infusion doses of up to 5mg/hr use low dose infusion mixture of 50mg in 50ml of compatible IV fluid; for infusion doses of greater than 5mg/hr use high dose infusion mixture with undiluted Lasix high dose infusion (ie 250mg in 25ml or 500mg in 50ml)
- Rate of infusion should not exceed 4mg/min
- Compatible with Normal saline .

Note: glucose solutions are unsuitable

- Store at room temperature; protect from light
- Dilutions in compatible IV fluid are stable for 24 hours at room temperature – discard ifnot used within 24 hours. Do not use if solutions have a yellow colour or contain crystaldeposits

5– DOSAGE:-

PO

- Usual dosage from 10mg daily to 80mg three times a day

IV

- Dosage is highly individualised. 5mg may be sufficient to cause significant diuresis inthe frusemide naïve patient.

- Doses of 100mg/hr by infusion may be required in thosewith significant renal impairment.

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  - <10 - dose as in normal renal function; increased doses may be required
  - 10-20 - dose as in normal renal function; increased doses may be required
  - >20-50 - dose as in normal renal function
- Dose in renal replacement therapy
  - CAPD not indicated
  - HD not indicated

7- DOSAGE IN PAEDIATRICS:-

IV/ PO

- Usually, 0.5-1mg/kg 6 hourly to four times a day.
- IV infusion: 50mg/kg in 50ml of normal saline at 0.1-1 mg/kg/hr (i.e 0.1-1ml/hr)

8- CONTRAINDICATIONS:-

Known hypersensitivity to frusemide

9- WARNINGS :-

- Allergy to Sulfur drugs

  Patients allergic to sulfonamides may also be allergic to frusemide.
- Ototoxicity

Cases of tinnitus and reversible or irreversible hearing impairment have been reported.Usually, reports indicate that frusemide ototoxicity is associated with rapid injection,severe renal impairment, doses exceeding several times the usual recommended dose,or concomitant therapy with aminoglycoside antibiotics or other ototoxic drugs.

10- PRECAUTIONS :-

- Excessive diuresis may cause dehydration and blood volume reduction with Circulatory collapse as with any effective diuretic, electrolyte depletion may occur during
- frusemide therapy,especially in patients receiving higher doses and a restricted salt intake. Hypokalaemia may develop with frusemide, especially with brisk diuresis, inadequate oral electrolyte intake, when cirrhosis is present, or during concomitant use of corticosteroids or ACTH.Digitalis therapy may exaggerate metabolic effects of hypokalaemia, especially myocardial effects.Asymptomatic hyperuricaemia can occur and gout may rarely be precipitated.

11- Laboratory Tests:-

No tests in addition to routine ICU tests are required.

12- Drug/Laboratory Test Interactions :-

None noted.

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Frusemide may increase the ototoxic potential of aminoglycoside antibiotics, especially in the presence of impaired renal function.
- Except in life-threatening situations, avoid this combination.Lithium generally should not be given with diuretics because they reduce lithium's renal clearance and add a high risk of lithium toxicity.

14- ADVERSE REACTIONS :-

- Gastrointestinal System Reactions
  Pancreatitis, jaundice (intrahepatic cholestatic juandice), anorexia, oral and Gastricirritation, cramping, diarrhoea, constipation, nausea, and vomiting.
- Systemic Hypersensitivity Reactions
  Systemic vasculitis, interstitial nephritis, and necrotizing angiitis.
- Central Nervous System Reactions
  Tinnitus and hearing loss, paraesthesias, vertigo, dizziness, headache, blurred vision,and xanthopsia.
- Haematologic Reactions
  Aplastic anaemia (rare), thrombocytopaenia, agranulocytosis (rare), Haemolyticanaemia, leukopaenia, and anaemia.
- Dermatologic-Hypersensitivity Reactions
  Exfoliative dermatitis, erythema multiforme, purpura, photosensitivity, urticaria, rash,and pruritus.
- Cardiovascular Reaction
  Orthostatic hypotension may occur and be aggravated by alcohol, barbiturates ornarcotics.
- Other Reactions

Hyperglycaemia, glycosuria, hyperuricaemia, muscle spasm, weaknesses, restlessness, urinary bladder spasm, thrombophlebitis, and fever.

1- ADMINISTRATION ROUTES:-

IV, IM

2- CLINICAL PHARMACOLOGY:-

- Glucagon for injection (rDNA origin) is a polypeptide hormone identical to Humanglucagon that increases blood glucose and relaxes smooth muscle of Thegastrointestinal tract. Glucagon has positive inotropic and chronotropic effects similar tothose of beta adrenergic agonists. These occur due to binding to specific intracellularglucagon receptors leading to activation of cardiac adenylate cyclase and increasecAMP concentrations

3 - ICU INDICATIONS:-

Treatment of beta blocker or calcium channel blocker overdoses that are refractory to standard management with fluids, inotropes and calcium

Note: glucagon is not recommended as a 1st line treatment of hypoglycaemia in the ICU

4- PRESENTATION AND ADMINISTRATION:-

IV

- 1mg vial + phenol containing solvent (prefilled syringe)1 unit = 1 mg
- FOR INFUSIONS, DO NOT USE SOLVENT THAT COMES WITH THE VIAL. Instead,reconstitute 25 vials of glucagon using water for injection, then dilute to a total of 25mlusing 5% dextrose (i.e. 1mg/ml)
- Compatible with 5% dextrose Water for injection
- Store at room temperature

IM

- Dissolve 1mg vial in phenol containing solvent (prefilled syringe) and administer by IM Injection

5– DOSAGE:-

- For treatment of beta blocker or calcium channel blocker overdoses
  - i- Give an initial bolus of 5mg IV. If no response, repeat after 5 minutes.
  - ii- If there is an adequate clinical response to the loading dose, commence an IVinfusion of 2-5mg/hr

Note: if there is no clinical response to an initial loading dose of 10mg of glucagon, further administration of the drug is futile and use of glucagon should be abandoned.

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

7- DOSAGE IN PAEDIATRICS:-

Beta blocker overdose: 0.1mg/kg IV stat followed by 0.3-2 mcg/kg/min

8– CONTRAINDICATIONS:-

Hypersensitivity to glucagon

9- WARNINGS :-

Glucagon is not a first line therapy for beta blocker or calcium channel overdose. Itsuse is not supported by adequate clinical trials. Glucagon therapy should be used onlyfor patients who are refractory to fluids and inotropes.

10- PRECAUTIONS :-

General

Generalised allergic reactions, including urticaria, respiratory distress, and hypotension,have been reported in patients who received glucagon by injection

11- Laboratory Tests :-

No tests in addition to routine ICU tests are indicated

12- Drug/Laboratory Test Interactions :-

None reported

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

None of note

14 - ADVERSE REACTIONS :-

- Body as a whole
  Allergic reaction
- Metabolic and endocrine
  Hyperglycaemia, hypokalaemia
- Gastrointestinal
  Nausea, vomiting

GLYCERYL TRINITRATE :-

1- ADMINISTRATION ROUTES:-

IV, Sublingual, Transdermal

2- CLINICAL PHARMACOLOGY:-

- The principal pharmacologic action of nitroglycerin is relaxation of vascular smooth muscle, producing a vasodilator effect on both peripheral arteries and veins with morepromінent effects on the latter. Dilation of the postcapillary vessels, including large veins, promotes peripheral pooling of blood and decreases venous return to the heart,thereby reducing left ventricular end-diastolic pressure (preload). Arteriolar relaxation reduces systemic vascular resistance and arterial pressure (afterload).

3 - ALTERNATIVE NAMES:-

GTN, Nitronal, Nitrolingual, Nitroderm

4- ICU INDICATIONS:-

i- Afterload reduction / peripheral vasodilation
ii- Treatment of hypertension
iii- Treatment of angina

5- PRESENTATION AND ADMINISTRATION:-

- IV,Nitronal 50ml contains 50mg of GTN in 50ml of 5% dextrose, Use undiluted

Note:- GTN is readily absorbed into many plastics. Original Perfusor PE tubing causes minimal absorption and is preferred. If other plastics are used, GTN may be absorbedby the tubing particular when running at low rates.

- Compatible with 5% dextrose normal saline glucose and sodium chloride
- Do not mix with other medications
- Store at room temperature and protect for light
- Transdermal

  Apply once daily to chest or upper arm for 12-18 hours (brand dependent) followed by a6-12 hour nitrate-free period (usually overnight)

- Sublingual tablets

  Dinitra 5 mg tablet

- Sublingual spray

  Glytrin spray 400mcg/dose

  Nitrolingual pump spray 400mcg/dose

6– DOSAGE:-

- IV infusion

  IV infusion dose range is 0-12ml/hr (equivalent to 0-200mcg/min).
  In ICU it is usuallyappropriate to commence the infusion at 5ml/hr and to titrate to effect.

- Transdermal

  Usually commence with 5mg/24 hours patch; maximum two 10mg/24 hours patches

- Sublingual tablets

  1 tablet under the tongue every 3-5 minutes as required

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS

IV infusion

<30kg 3mg/kg in 50ml 5% dextrose at 0.5-5ml/hr (0.5-5mcg/kg/min)

>30kg 3mg/kg in100ml 5% dextrose at 1-10ml/hr (0.5-5mcg/kg/min)

9- CONTRAINDICATIONS:-

known hypersensitivity to glyceryl trinitrate

10 – WARNINGS :-

Occasionally, high dose GTN may lead to worsened oxygenation due to Increased shunting

11- PRECAUTIONS :-

General

GTN may lead to severe hypotension in patients with haemodynamically Significant aortic stenosis.

12- Laboratory Tests :-

No tests in addition to routine ICU tests are required

13- Drug/Laboratory Test Interactions :-

None of note

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Amplification of the vasodilatory effects of nitroglycerin by sildenafil can result in severehypotension. additive effects may be observed when GTN is combined with other antihypertensives

15- ADVERSE REACTIONS :-

- Body as a Whole
  Allergic reactions
- Cardiovascular System
  Tachycardia, hypotension, syncope, rebound hypertension, palpitations
- Gastrointestinal System
  Nausea, vomiting, abdominal pain
- Central Nervous System
  Headache
- Haematological System
  Methaemoglobinaemia

HALOPERIDOL :-

1- ADMINISTRATION ROUTES:-

IV, IM, PO

Note:- Haldol (Haloperidol decanoate) which has anextended duration of action, is administered by IM depot injection and is not used in ICU

2- CLINICAL PHARMACOLOGY:-

Haloperidol is the first of the butyrophenone series of major tranquilizers. The precisemechanism of action has not been clearly established.

3- ICU INDICATIONS:-

i- Delirium
ii- Psychosis

4- PRESENTATION AND ADMINISTRATION:-

IV

- Haloperidol 5mg in 1ml (solution)
- Administer slowly over 1-2 minutes or as a bolus, undiluted or diluted in 5-10ml ofnormal saline.
- May be diluted in compatible IV fluid and administered over 10-30 minutes Undiluted solution may discolour if exposed to light.
- Discoloured solutions should notbe used.
- Compatible with Normal saline 5% , dextrose .

- Store at room temperature and protect from light

PO

- Tablets

Serenace 0.5mg tablets , Serenace 1.5mg , Serenace 5mg .

- Liquid

Serenace 2mg/ml (20 drops is equal to 1ml)

5- DOSAGE:-

IV/IM

i- ICU delirium and psychosis

0.5mg-10mg as required. Usual maximum daily dose is 100mg although much higherdoses have been described.

ii- PO

0.5mg-20mg as required. Usual maximum daily dose is 100mg although much higherdoses have been described.

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]

<10 - Dose as in normal renal function

10-20 - Dose as in normal renal function

>20-50 - Start with lower doses. For single doses use 100% of normal dose.

- Avoid repeated dosage because of accumulation

- Dose in renal replacement therapy

CAPD Start with lower doses. For single doses use 100% of normal dose.
Avoid repeated dosage because of accumulation

HD Start with lower doses. For single doses use 100% of normal dose.
Avoid repeated dosage because of accumulation

7- DOSAGE IN PAEDIATRICS:-

IV, IM, PO

0.01mg/kg daily; increased to 0.1mg/kg 12 hourly

8– CONTRAINDICATIONS:-

i- Hypersensitivity to haloperidol

ii- Parkinson's disease

9- WARNINGS :-

- Tardive Dyskinesia

A syndrome consisting of potentially irreversible, involuntary, dyskinetic movements may develop in patients treated with antipsychotic drugs. The syndrome usually developswith high doses given over a prolonged period; however, it can develop, although muchless commonly, after relatively brief treatment periods at low doses.

- Neuroleptic Malignant Syndrome (NMS)

A potentially fatal symptom complex referred to as Neuroleptic Malignant Syndrome (NMS) has been reported in association with antipsychotic drugs.

10- PRECAUTIONS :-

- General

Haloperidol may lower the seizure threshold Severe neurotoxicity (rigidity, inability to walk or talk) may occur in patients withthyrotoxicosis who are also receiving antipsychotic medication, including haloperidol.

11-Laboratory Tests :-

No tests in addition to routine ICU tests are required

12- Drug/Laboratory Test Interactions :-

None noted

13-IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Combined Use of Haloperidol and Lithium An encephalopathic syndrome (characterised by weakness, lethargy, fever, tremulousness and confusion, extrapyramidal symptoms, leukocytosis, elevated serum enzymes, BUN, and FBS) followed by irreversible brain damage has occurred in a few patients treated with lithium plus haloperidol. A causal relationship between these events and the concomitant administration of lithium and haloperidol has not been established; however, patients receiving such combined therapy should be monitored closely for early evidence of neurological toxicity and treatment discontinued promptly if such signs appear.

14-ADVERSE REACTIONS :-

- Body as a Whole

Neuroleptic malignant syndrome (NMS), hyperpyrexia and heat stroke have Been reported with haloperidol.

- Central Nervous System

Extrapyramidal Symptoms (EPS), tardive dyskinesia, insomnia, restlessness, anxiety, euphoria, agitation, drowsiness, depression, lethargy, headache, confusion, vertigo,grand mal seizures, exacerbation of psychotic symptoms including hallucinations, andcatatonic-like behavioral states

- Cardiovascular

Tachycardia, hypotension, hypertension and ECG changes including prolongation of the Q-T interval and torsades de pointes.

- Haematological

Mild and usually transient leukopaenia and leukocytosis, minimal decreases in red blood cell counts, anaemia, or a tendency toward lymphomonocytosis. Agranulocytosishas rarely been reported to have occurred with the use of haloperidol, and then only inassociation with other medication.

- Endocrine Disorders

Lactation, breast engorgement, mastalgia, menstrual irregularities, gynecomastia,impotence, increased libido, hyperglycaemia, hypoglycaemia and hyponatraemia.

- Gastrointestinal Effects

Anorexia, constipation, diarrhoea, hypersalivation, dyspepsia, jaundice, nausea And vomiting.

- Autonomic Reactions

Dry mouth, blurred vision, urinary retention, diaphoresis and priapism.

- Respiratory Effects

Laryngospasm, bronchospasm and increased depth of respiration.

HEPARIN :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Heparin, Multiparin

3- CLINICAL PHARMACOLOGY:-

Heparin inhibits reactions that lead to the clotting of blood and the formation of fibrin clots both in vitro and in vivo. Heparin acts at multiple sites in the normal coagulationsystem. Small amounts of heparin in combination with antithrombin III (heparin cofactor)can inhibit thrombosis by inactivating activated Factor X and inhibiting the conversion ofprothrombin to thrombin.

4- ICU INDICATIONS:-

Anticoagulation

5- PRESENTATION AND ADMINISTRATION:-

IV

- 5000 units/ml in 5ml vials (25000 units); other formulations also available
- For administration of heparin by infusion, prepare 25000 units of heparin in 50mls of
- compatible IV fluid
- Administer via a dedicated central line or peripheral line.
- Discard any solution not used within 24 hours or preparation
- Compatible with 5% dextrose normal saline .
- Store at room temperature

6- DOSAGE:-

IV

- Use the following protocol for heparin infusion in the ICU ONLY .
  All doses are inunits/kg and should berounded to the nearest 100 units (note: 100 unitsequals 0.2ml when heparin isprepared according to the standard dilutionabove).
- APTT should be measured 6 hourly.

Note:- Follow up hearin dose

i- Initial dose 80 units/kg bolus + 18 units/kg/hrinfusion

- aPTT <35 sec give 80 units/kg bolus + increase infusion rate by 4 units/kg/hr
- aPTT 35-45 sec give 40 units/kg bolus + increase infusion rate by 2 units/kg/hr
- aPTT >45-60 - Increase infusion rate by 2 units/kg/hr
- aPTT >60-80 - No change
- aPTT >80-90 - Decrease infusion rate by 2 units/kg/hr
- aPTT >90 Hold infusion for 1 hour + decrease infusion rate by 3 units/kg/hr

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8-DOSAGE IN PAEDIATRICS:-

IV

75-200 units/kg stat followed by infusion commencing at 15 units/kg/hr
Infusion made up as follows: 500 units / kg in 50ml at 0-2.5 ml/hr (0-25 units/kg/hr) adjusted according to APTT

9- CONTRAINDICATIONS:-

Severe thrombocytopaenia

10- WARNINGS :-

- Hypersensitivity

  Patients with documented hypersensitivity to heparin should be given the drug only in clearly life-threatening situations.
- Haemorrhage

  Haemorrhage can occur at virtually any site in patients receiving heparin. An unexplained fall in hematocrit, fall in blood pressure, or any other unexplained symptom should lead to serious consideration of a haemorrhagic event. Heparin sodium should be used with extreme caution in disease states in which there is increased danger of haemorrhage
- Thrombocytopaenia

  Thrombocytopaenia has been reported to occur in patients receiving heparin with a reported incidence of 0% to 30%. Mild thrombocytopaenia (count greater than 100,000/mm3) may remain stable or reverse even if heparin is continued. However, reduction inplatelet count of any degree should be monitored closely. If the count falls below100,000/mm3 or if recurrent thrombosis develops, the heparin product should bediscontinued.

11- PRECAUTIONS :-

- General

  Heparin induced thrombocytopaenia thrombosis syndrome (HITTS)

It has been reported that patients on heparin may develop new thrombus formation in association with thrombocytopaenia resulting from irreversible aggregation of plateletsinduced by heparin, the so-called "white clot syndrome". The process may lead to severe thromboembolic complications like skin necrosis, gangrene of the extremitiesmay lead to amputation, myocardial infarction, pulmonary embolism, stroke, and possibly death.
Therefore, heparin administration should be promptly discontinued if a patient develops new thrombosis in association with a reduction in platelet count.

- Heparin Resistance

Increased resistance to heparin is frequently encountered in fever, thrombosis, thrombophlebitis, infections with thrombosing tendencies, myocardial infarction, cancer,
in postsurgical patients, and patients with antithrombin III deficiency.

12- Laboratory Tests :-

Patients in ICU on a heparin infusion should have their aPTT measured 6 hourly.

13- Drug/Laboratory Test Interactions :-

- Pregnancy

Animal reproduction studies have not been conducted with heparin sodium. It is also not known whether heparin sodium can cause foetal harm when administered to a pregnant woman or can affect reproduction capacity.
Heparin sodium should be given to a pregnant woman only if clearly needed.

- Nursing Mothers

Heparin is not excreted in human milk.

- Paediatric Use

See DOSAGE IN PAEDIATRICS

14 - IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Concomitant administration with warfarin, aspirin, activated protein C and enoxaparin increases the risk of bleeding.
- Digitalis, tetracyclines, nicotine, or antihistamines may partially counteract the anticoagulant action of heparin sodium.

15- ADVERSE REACTIONS :-

- Body as a Whole

Haemorrhage, anaphylactic reactions

- Gastrointestinal System:

Nausea, vomiting

- Respiratory System

Angioedema, asthma-like symptoms

- Haematological System:

Thrombocytopaenia, HITTS (see PRECAUTIONS)

HYDRALAZINE :-

1- ADMINISTRATION ROUTES:-

IV, PO

2- CLINICAL PHARMACOLOGY:-

- Although the precise mechanism of action of hydralazine is not fully understood, The major effects are on the cardiovascular system. Hydralazine apparently lowers blood pressure by exerting a peripheral vasodilating effect through a direct relaxation of vascular smooth muscle

3- ALTERNATIVE NAMES:-

Apresoline

4- ICU INDICATIONS:-

Afterload reduction / peripheral vasodilation

5- PRESENTATION AND ADMINISTRATION:-

- IV

  20mg vial of powder Reconstitute with 1ml of water for injection For direct injection, nject as either reconstituted solution or further dilute with a small volume of normal saline. Give over 1-2 minutes For IV infusion reconstitute 100mg and add to 100ml of compatible IV fluid

- Compatible with Normal saline .

Note : 5% dextrose should not be used as glucose rapidly causes hydralazine to be broken down.

- Prepare solutions immediately before use and discard after 24 hours.
- Hydralazine undergoes colour changes in most infusion fluids; however, these changes generally do not indicate loss of potency.
- Store at room temperature.

- PO

Rarely indicated in ICU

6- DOSAGE:-

IV

5mg IV stat, then up to 20mg per hour by infusion.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY :-

Start with a small dose and adjust in accordance with response

8- DOSAGE IN PAEDIATRICS:-

IV

0.1-0.2mg/kg stat, then 4-6mcg/kg/min

9- CONTRAINDICATIONS:-

Hypersensitivity to hydralazine

10- WARNINGS :-

In a few patients hydralazine may produce a clinical picture simulating systemic Lupuserythematosus including glomerulonephritis. In such patients hydralazine should bediscontinued unless the benefit-to-risk determination requires continued antihypertensive therapy with this drug.

11- PRECAUTIONS :-

- General
  - Myocardial stimulation produced by hydralazine can cause anginal attacks and ECG changes of myocardial ischemia. The drug has been implicated in the production ofmyocardial infarction. It must, therefore, be used with caution in patients with suspectedcoronary artery disease
  - Peripheral neuritis, evidenced by paraesthesia, numbness, and tingling, has been observed.

12- Laboratory Tests :-

No tests in addition to routine ICU tests are required

13 - Drug/Laboratory Test Interactions :-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Concomitant administration with other antihypertensives increases the risk of hypotension

15- ADVERSE REACTIONS :-

- Body as a Whole
  Rash, urticaria, pruritus, fever, chills
- Cardiovascular System
  Hypotension, paradoxical pressor response, oedema, palpitations, tachycardia, Angina pectoris
- Respiratory System
  Dyspnea.
- Gastrointestinal System
  Constipation, paralytic ileus, anorexia, vomiting, diarrhoea,
- Haematological System
  Blood dyscrasias, consisting of reduction in haemoglobin and red cell count, leukopaenia, agranulocytosis, purpura; lymphadenopathy; splenomegaly.
- Neurological System
  Headache, peripheral neuritis, evidenced by paraesthesia, numbness, and tingling;dizziness; tremors; muscle cramps; psychotic reactions characterised by depression,disorientation, or anxiety.

HYDROCORTISONE :-

1 - ADMINISTRATION ROUTES:-

IV, PO

2- ALTERNATIVE NAMES:-

Solu-Cortef

3- CLINICAL PHARMACOLOGY:-

Hydrocortisone is a naturally occurring steroid hormone which has glucocorticoid And mineralocorticoid properties

4- ICU INDICATIONS:-

i- Relative corticosteroid insufficiency in patients with severe septic shock
ii- Adrenal insufficiency
iii- Steroid responsive inflammatory conditions

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 100mg/2ml vial plus benzyl alcohol diluent
  - Reconstitute by pressing down on the plastic activator. This forces the diluent into the lower compartment. Gently agitate to dissolve powder. To withdraw solution, removethe plastic tab covering the stopper. Wipe the top of the stopper with an alcohol swab.Insert drawing up needle through the centre of the stopper until the tip is just visible.Invert vial and withdraw dose.
  - Reconstituted solutions and solutions with concentrations not exceeding 1mg/ml arestable for up to 24 hours.
  - Compatible with the Normal saline , 5% dextrose Glucose .
  - Can be administered by infusion; however, preferred method in our ICU is administration by direct IV injection. Reconstituted solution is generally injection undiluted by slow IV injection.

6- DOSAGE:-

- IV

Usual dose is 50mg 6 hourly for septic shock; however, many different dosage Regimens exist for various indications (for most ICU indications 50mg 6 hourly is an appropriatedose)

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

- IV

0.5-4mg/kg 6 hourly

8- CONTRAINDICATIONS:-

The use of hydrocortisone sodium succinate sterile powder is contraindicated in premature infants because the 100, 250, 500and 1000 mg ACT-O-VIAL System contain benzyl alcohol. Benzyl alcohol has been reported to be associated with a fatal "Gasping Syndrome" in premature infants.

9- WARNINGS :-

- Steroid induced myopathy

An acute myopathy has been observed with the use of high doses of corticosteroids,most often occurring in patients with disorders of neuromuscular transmission (e.g.,myasthenia gravis), or in patients receiving concomitant therapy with neuromuscularblocking drugs. This acute myopathy is generalized, may involve ocular and respiratorymuscles, and may result in quadriparesis. Elevations of creatine kinase may occur.

Clinical improvement or recovery after stopping corticosteroids may require weeks to years.

- Adrenal-insufficiency due to steroids:

In patients on corticosteroid therapy subjected to unusual stress, increased dosage of rapidly acting corticosteroids before, during, and after the stressful situation is indicated.

- Infections

Corticosteroids may mask some signs of infection, and new infections may Appear during their use.

- Blood pressure

Average and large doses of hydrocortisone can cause elevation of blood pressure, salt and water retention, and increased excretion of potassium. These effects are less likely to occur with the synthetic derivatives except when used in large doses.

10- PRECAUTIONS :-

- General
  - There is an enhanced effect of corticosteroids in patients with hypothyroidism and in those with cirrhosis.
  - Psychic derangements may appear when corticosteroids are used, ranging From euphoria, insomnia, mood swings, personality changes, and severe depression to frankpsychotic manifestations. Also, existing emotional instability or psychotic tendenciesmay be aggravated by corticosteroids.

11- Laboratory Tests :-

No tests in addition to routine ICU tests are required

12- Drug/Laboratory Test Interactions :-

None known

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

The pharmacokinetic interactins listed below are potentially clinically important. Drugs that induce hepatic enzymes such as phenobarbital, phenytoin and rifampin mayincrease the clearance of corticosteroids and may require

increases in corticosteroiddose to achieve the desired response.

14- ADVERSE REACTIONS :-

- Fluid and Electrolyte Disturbances

  Sodium retention; fluid retention; congestive heart failure in susceptible patients;potassium loss; hypokalemic alkalosis; hypertension.

- Musculoskeletal

  Muscle weakness; steroid myopathy, loss of muscle mass; osteoporosis; Tendon rupture, particularly of the Achilles tendon; vertebral compression fractures; asepticnecrosis of femoral and humeral heads; pathologic fracture of long bones.

- Gastrointestinal

  Peptic ulcer with possible perforation and haemorrhage; pancreatitis; Abdominal distention; ulcerative oesophagitis; increases in alanine transaminase (ALT, SGPT),aspartate transaminase (AST, SGOT) and alkaline phosphatase have been observedfollowing corticosteroid treatment.

- Dermatologic

  Impaired wound healing; thin fragile skin; petechiae and ecchymoses; facial erythema; increased sweating; may suppress reactions to skin tests.

- Neurological

  Convulsions; increased intracranial pressure with papilloedema (pseudotumour cerebri) usually after treatment; vertigo; headache.

- Endocrine

  Menstrual irregularities; development of Cushingoid state; suppression of growth in children; secondary adrenocortical and pituitary unresponsiveness, particularly in timesof stress, as in trauma, surgery or illness; decreased carbohydrate tolerance;
  manifestations of latent diabetes mellitus; increased requirements for insulin or oral hypoglycaemic agents in diabetics.

IPRATROPIUM BROMIDE :-

1- ADMINISTRATION ROUTES:-

Inhaled, Nebulised

2- ALTERNATIVE NAMES:-

Atrovent, Combivent (ipratropium + salbutamol)

3- CLINICAL PHARMACOLOGY:-

Ipratropium bromide is an anticholinergic (parasympatholytic) agent. Anticholinergicsprevent the increases in intracellular concentration of cyclic guanosine monophosphate(cyclic GMP) which are caused by interaction of acetylcholine with the muscarinicreceptor on bronchial smooth muscle.

4- ICU INDICATIONS:-

Bronchospasm

5- PRESENTATION AND ADMINISTRATION:-

- Inh
  - Atrovent inhaler 20mcg/dose
  - Combivent inhaler 20mcg atrovent per dose and 100mcg salbutamol per dose
- Neb
  - Ipratropium steri-neb 500mcg/2ml

6- DOSAGE:-

- Inh

  2 puffs 4 times per day or, if ventilated, 5 puffs via metered dose inhaler adaptor intoventilator circuit
- Neb

  1 vial of Ipratropium four times a day

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

Neb

0.25-1ml of 250mcg/ml solution diluted to 4ml. In a severe attack administer every 20minutes for 3 doses then administer 4 to 6 hourly after that.

9- CONTRAINDICATIONS :-

i- Hypersensitivity to ipratropium bromide

ii- Hypersensitivity to atropine or its derivatives.

10- WARNINGS :-

Immediate hypersensitivity reactions may occur after administration of Ipratropiumbromide, as demonstrated by rare cases of urticaria, angioedema, rash, bronchospasm,anaphylaxis and oropharyngeal edema.

Inhaled medicines, including ipratropium bromide, may cause paradoxical

bronchospasm. If this occurs, treatment with ipratropium bromide aerosol should bestopped and other treatments

11- PRECAUTIONS :-

- General

Ipratropium should be used with caution in patients with narrow-angle glaucoma,prostatic hypertrophy or bladder-neck obstruction.

12- Laboratory Tests:-

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions :-

None noted.

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

None of note.

15- ADVERSE REACTIONS :-

- Body as a Whole

Back pain, headache

- Central and Peripheral Nervous System

Dizziness

- GI System

Dyspepsia, mouth dry, nausea

- Respiratory System

Coughing, dyspnoea, rhinitis, sinusitis

- Urinary System

Urinary tract infection

ISOPRENALINE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Isuprel

3- CLINICAL PHARMACOLOGY:-

Isoproterenol hydrochloride is a synthetic sympathomimetic amine that is Structurallyrelated to epinephrine but acts almost exclusively on beta receptors.

4- ICU INDICATIONS:-

Bradycardia

Note:- current international guidelines do not recommend isoprenaline as the first Lineagent to treat any condition.

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 200mcg isoprenaline in 1ml and 1mg in 5ml (1:5000) vials
  - For IV infusion, add 1mg to 50ml of compatible IV fluid and administer at 0-60ml/hr(0-20mcg/min)
  - Compatible with Normal saline glucose .
  - Refrigerate. Do not freeze. Protect from light and air.
  - Discard any diluted fluid not used within 24 hours of preparation
  - Do not use solution if pinkish to brown in colour or contains precipitate

6- DOSAGE:-

-IV

Usual dosage is 0.5mcg/min to 5mcg/min although doses of 20mcg/min or greater havebeen used. For bolus dosing, can dilute 200mcg in 20ml and administer 1ml bolus.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

- IV infusion

300mcg/kg in 50ml of compatible IV fluid. Commence infusion at 0.1mcg/kg/min (1ml/hr) and titrate to effect.

9- CONTRAINDICATIONS :-

i- Heart block caused by digitalis intoxication

ii- Known hypersensitivity to isoprenaline

10- WARNINGS :-

- Potential for worsening of cardiac function

  Isoprenaline, by increasing myocardial oxygen requirements while decreasing Effectivecoronary perfusion, may have a deleterious effect on the injured or failing heart.

- Worsening of heart block

  In a few patients, presumably with organic disease of the AV node and its branches,isoprenaline has paradoxically been reported to worsen heart block

or to precipitateAdams-Stokes attacks during normal sinus rhythm or transient heart block.

- Contains sulfite

Contains sodium metabisulfite, a sulfite that may cause allergic-type reactions Includinganaphylactic symptoms and life-threatening or less severe asthmatic episodes in certainsusceptible people.

11- PRECAUTIONS

- General

Isoprenaline should generally be started at the lowest recommended dose. This may begradually increased if necessary while carefully monitoring the patient. Doses sufficientto increase the heart rate to more than 130 beats per minute may increase thelikelihood of inducing ventricular arrhythmias. Such increases in heart rate will also tendto increase cardiac work and oxygen requirements which may adversely affect the failing heart or the heart with a significant degree of arteriosclerosis.

Particular caution is necessary in administering isoprenaline to patients with Coronary artery disease, coronary insufficiency, diabetes, hyperthyroidism, and sensitivity to sympathomimetic amines.

12- Laboratory Tests:-

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions :-

None noted.

14-IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Isoprenaline and adrenalin should not be administered simultaneously because Bothdrugs are direct cardiac stimulants and their combined effects may induce Seriousarrhythmias.Beta receptor blocking agents and isoprenaline inhibit the effects of each other.

15- ADVERSE REACTIONS :-

- CNS

Nervousness, headache, dizziness.

- Cardiovascular

Tachycardia, palpitations, angina, Adams-Stokes attacks, pulmonary edema, hypertension, hypotension, ventricular arrhythmias, tachyarrhythmias.

- Other

Flushing of the skin, sweating, mild tremors, weaknes

KETAMINE :-

1- ADMINISTRATION ROUTES:-

IV

2-ALTERNATIVE NAMES:-

Ketalar

3- CLINICAL PHARMACOLOGY:-

Ketamine is a rapid-acting general anaesthetic producing an anaesthetic state characterised by profound analgesia, normal pharyngeal-laryngeal reflexes, normal orslightly enhanced skeletal muscle tone, cardiovascular and respiratory stimulation, andoccasionally a transient and minimal respiratory depression.

4- ICU INDICATIONS:-

i- Analgesia
ii- Induction of anaesthesia

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 200mg/2ml vial
  - Compatible with : Normal saline, 5% dextrose
  - Store at room temperature
  - For infusion dilute with compatible IV fluid to a dilution of 1mg/ml (e.g. 50mg in 50ml)

6- DOSAGE:-

- IV

i- Induction of anaesthesia
100-200mg IV

ii- Analgesia
Usual dilution 1mg/ml. Bolus doses of 1-2mg. Background infusion of 5mg/hr if required.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Specific guidelines for dosage adjustments in renal impairment are not available; It appears that no dosage adjustments are needed.

8- DOSAGE IN PAEDIATRICS:-

i- Induction of anaesthesia
1-2mg/kg IV

ii- Analgesia
0-4mcg/kg/min

9- CONTRAINDICATIONS :-

Any condition where severe hypertension would constitute a serious hazard

10- WARNINGS :-

Emergency reactions have been occurred in approximately 20% . the psychological manifestations vary in severity between pleasant dream-like states ,vivid imagery , hallucinations and , in some cases these states have been accompanied by confusion ,excitement and irrational behaviour . these changes lasts few hours and may recure up to 24 hours ,the incidence of these changes is least in old age more than 65 years and in younger than

15 years .

11- PRECAUTIONS :-

- General

An increase in intracranial pressure has been reported following administration Ofketamine. Use with extreme caution in patients with raised intracranial pressure.

12-Laboratory Tests:-

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions :-

None noted.

14 -IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

None of note.

15- ADVERSE REACTIONS :-

- General

Anaphylaxis. Local pain and exanthema at the injection site have infrequently Beenreported. Transient erythema and/or morbilliform rash have also been reported.

- Cardiovascular

Blood pressure and pulse rate are frequently elevated following administration Of ketamine. However, hypotension and bradycardia have been observed. Arrhythmia hasalso occurred.

- Respiratory

Although respiration is frequently stimulated, severe depression of respiration or apneamay occur following rapid intravenous administration of high doses of ketamine.Laryngospasms and other forms of airway obstruction have occurred during ketamineanaesthesia.

- Neurological

In some patients, enhanced skeletal muscle tone may be manifested by tonic and clonicmovements sometimes resembling seizures

- Gastrointestinal

Anorexia, nausea and vomiting have been observed; however this is not usually severe

LABETALOL :-

1- ADMINISTRATION ROUTES:-

IV, PO

2- ALTERNATIVE NAMES:-

Hybloc, Trandate

3- CLINICAL PHARMACOLOGY:-

- Labetalol hydrochloride is an adrenergic receptor blocking agent that has both Selectivealpha1-adrenergic and nonselective beta-adrenergic receptor blocking actions in asingle substance.
- Labetalol is completely absorbed from the gastrointestinal tract with peak plasma levels occurring 1-2 hours after oral administration. The absolute bioavailability (fraction of drug reaching systemic circulation) of labetalol when compared to an IV infusion is 25%; this is due to extensive "first-pass" metabolism.Despite "first-pass" metabolism there is a linear relationship between oral doses of100-3000 mg and peak plasma levels. The absolute bioavailability of labetalol isincreased when administered with food.

4- ICU INDICATIONS:-

Hypertension

5- PRESENTATION AND ADMINISTRATION:-

- PO
  Hybloc 50mg, 100mg, 200mg, 400mg Tab
- IV
  100mg/20ml
- Bolus: 10-20mg over 2 minutes
  Infusion: 300mg in 60ml (undiluted) at a rate of 0-30 ml/hr (0-150mg/hr)
- Compatible with the :5% dextrose glucose and sodium chloride normal Saline .

6- DOSAGE:-

- PO
  50-100mg 12 hourly; may be increased to maximum of 600mg 6 hourly if required.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8-DOSAGE IN PAEDIATRICS:-

- PO
  1-2mg/kg 12 hourly; may increase to 10mg/kg 6 hourly

- IV
  0.25-0.5mg/kg over 2 minutes repeated every 10 minutes if required
- Infusion
  50mg/kg in 50ml of compatible IV fluid at 0-3ml/hr (0-3mg/kg/hr)

9- CONTRAINDICATIONS:-

i- Sinus bradycardia,
ii- Heart block greater than first degree,
iii- Cardiogenic shock,
iv- Overt cardiac failure
v- Asthma

10- WARNINGS :-

- Hepatic Injury

  Severe hepatocellular injury, confirmed by rechallenge in at least one case, Occursrarely with labetalol therapy. The hepatic injury is usually reversible, but hepatic necrosis and death have been reported.

- Cardiac Failure

  Sympathetic stimulation is necessary in supporting circulatory function in Congestive heart failure, and beta blockade carries the potential hazard of further depressing myocardial contractility and precipitating more severe failure.

- Discontinuation of therapy

  Discontinuation of therapy in a patient with coronary artery disease may lead to reboundangina, arrhythmia or myocardial infarction.

- Diabetes and Hypoglycaemia

  Beta blockers may mask tachycardia occurring with hypoglycaemia.

- Thyrotoxicosis

  Beta-adrenergic blockade may mask certain clinical signs (e.g., tachycardia) of hyperthyroidism. Abrupt withdrawal of beta blockade might precipitate a thyroid storm.

- Rapid Decreases of Blood Pressure

  Caution must be observed when reducing severely elevated blood pressure. A number of adverse reactions, including cerebral infarction, optic nerve infarction, angina, andischemic changes in the electrocardiogram have been reported with other agents when severely elevated blood pressure was reduced over time courses of several hours to aslong as 1 or 2 days. The desired blood pressure lowering should therefore be achieved over as long a period of time as is compatible with the patient's status.

11- PRECAUTIONS :-

General

Impaired Hepatic Function:

Labetalol should be used with caution in patients with impaired hepatic function since metabolism of the drug may be diminished.

12- Laboratory Tests:-

No tests in addition to routine ICU tests are required

14- Drug/Laboratory Test Interactions :-

- The presence of labetalol metabolites in the urine may result in falsely elevated levels ofurinary catecholamines, metanephrine, normetanephrine, and vanillylmandelic acidwhen measured by fluorimetric or photometric methods.
- In screening patientssuspected of having a pheochromocytoma and being treated with labetalol, a specificmethod, such as a high performance liquid chromatographic assay with solid phaseextraction should be employed in determining levels of catecholamines.

15- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Beta blockers may exacerbate the rebound hypertension which can follow the withdrawal of clonidine. Drugs possessing beta-blocking properties can blunt the bronchodilator effect of beta-receptor agonist drugs in patients with bronchospasm;therefore, doses greater than the normal anti-asthmatic dose of beta-agonist bronchodilator drugs may be required.

16- ADVERSE REACTIONS :-

- Body as a Whole
  Tiredness, Fatigue
- Cardiovascular System:
  Bradycardia, Cold extremities, Hypotension, Leg pain
- Respiratory System:
  Wheeziness, Dyspnoea
- Digestive System:
  Diarrhoea, Nausea, Hepatitis
- Nervous System:
  Dizziness, Vertigo, Light-headedness

LEVOSIMENDAN :-

1- ADMINISTRATION ROUTES:-

IV

2 - BRAND NAMES:-

Simdax

3- CLINICAL PHARMACOLOGY :-

Levosimendan is a calcium sensitiser which increases cardiac contractility by Enhancingthe sensitivity of the heart to calcium. Haemodynamic effects persists for at least 24hours and may be seen up to 9 days after discontinuation of a 24-hour infusion due tothe presence of active metabolites that reach maximum plasma concentrations about 48hours after the infusion has stopped.

4 - ICU INDICATIONS:-

Patients undergoing cardiac surgery who have impaired systolic function &evidenceof acute decompensated heart failure despite maximal medical therapy.

Note: Administration in ICU is only possible after discussion with the ICU Specialist.

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - Levosimendan comes in a vial containing 12.5mg in 5ml (2.5mg/ml).
  - Refrigerate.
  - Compatible with : D5W
  - Levosimendan can be safely co-administered with frusemide (10mg/ml), Digoxin(0.25mg/ml) or glyceryl trinitrate (0.1mg/ml)
  - Levosimendan is prepared by diluting **one 5ml** vial of 2.5mg/ml solution in **500ml of 5%dextrose** to make a **0.025mg/ml solution**.
  - Administer by infusion only.

Do NOT administer a loading dose as this increases the risk of adverse events.

i- Begin the infusion at a rate of 0.05mcg/kg/min (see Dosage table below).

ii- If this is tolerated for one hour, increase the infusion rate to 0.1mcg/kg/min.

iii- If this is tolerated for the subsequent hour, increase the infusion rate to 0.2mcg/kg/min. This is the maximum dose.

iv- Cease the levosimendan infusion after 24 hours.

- The blood pressure should be checked both 15 minutes & 1 hour after Either commencing the infusion or adjusting the infusion rate, if not already continuously monitored.

6– DOSAGE:-

The following infusion rates apply only to the 0.025mg/ml preparation of Levosimendanprepared as directed above.

Patient's weight(kg)	**Continuous infusion rate (mL/hr)**		
	0.05mcg/kg/min	**0.1mcg/kg/min**	**0.2mcg/kg/min**
40	5	10	19
50	6	12	24
60	7	14	29

70	8	17	34
80	10	19	38
90	11	22	43
100	12	24	48
110	13	26	53
120	14	29	58

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

No dose adjustment is required for mild to moderate renal failure but the Resultantincrease in active metabolite concentration may cause a more pronounced andprolonged haemodynamic effect. Levosimendan is contraindicated in severe renalimpairment (defined below). It is not removed by haemodialysis.

8- DOSAGE IN PAEDIATRICS:-

Levosimendan should not be administered to children or adolescents under 18 years ofage.

9- CONTRAINDICATIONS:-

i- Hypersensitivity to Levosimendan
ii- Severe hepatic impairment
iii- Severe renal impairment (creatinine clearance <30ml/min)
iv- Severe hypovolaemia (this potentiates the hypotensive effects)

10- WARNINGS :-

- Cardiovascular adverse effects

The most frequent adverse effects are hypotension, QT prolongation and Arrhythmias(ectopy, atrial fibrillation and ventricular tachycardia). If hypotension
or arrhythmiasoccur, the infusion should be stopped pending medical review after which the infusionmay be restarted at a lower dose.
Patients receiving a Levosimendan infusion should undergo continuous ECG Monitoringwith blood pressure monitored as described in 'Administration' guidelines above.

- Electrolytes

Levosimendan may cause a decrease in serum potassium concentration; Hypokalaemiashould be corrected prior to administration.

11- PRECAUTIONS :-

General

Co-administration with other drugs that prolong the QT interval should be Undertakenwith caution. Continuous ECG monitoring is required for these patients as well as forthose already showing arrhythmias prior to Levosimendan administration.

12-Laboratory Tests :-

No tests are required in addition to routine ICU blood tests; vigilance for &

correction ofhypokalaemia is recommended.

13- Drug/Laboratory Test Interactions :-

-Pregnancy use

Levosimendan has been given to only a limited number of pregnant women and womenof childbearing age without an increase in the frequency of malformation on the humanfetus having been observed. Animal studies have shown evidence of an increasedoccurrence of fetal damage of uncertain significance in humans.

- Nursing Mothers use

Levosimendan is excreted into maternal milk in animal studies. No human data isavailable.

14 - Paediatric Use :-

Levosimendan should not be administered to children or adolescents under 18 years ofage.

15- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

See PRECAUTION

16- ADVERSE REACTIONS :-

- Nervous system

Headaches, dizziness, insomnia

- Cardiovascular

Arrhythmias (VT, AF, ventricular extrasystoles, tachycardia), hypotension

- Digestive

Diarrhoea, vomiting, constipation, nausea

MAGNESIUM SULPHATE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Magnesium Sulphate injection 10 %
Magnesium Sulphate injection 50%

3- ICU INDICATIONS:-

i- Hypomagnaesia

ii- Atrial arrhythmias, torsades de pointes and ventricular ectopy
iii- Eclampsia
iv- Asthma

4- PRESENTATION AND ADMINISTRATION:-

IV

i- Injection 50% in 5ml solution contains 2.5 gm of magnesium sulphate
ii- Injection 10% in 10 ml solution contains 1gm of magnesium sulphate

Note:- (1gm MgSo4 = 8 mlEq)

- Store at room temperature
  May be administered by direct IV injection provided that the concentration injected doesnot exceed 20% and the rate of infusion does not exceed 150mg/min (0.75ml/min of20% solution). A 20% solution can achieved by diluting 5ml of 50 % solution with atleast 12.5ml of compatible IV fluid.
- In an emergency, to treat Torsade de pointes,2 gm can be administered by direct IV injection over 1-2 minutes (preferably via acentral line).
- The usual means of administration in ICU is by intermittent infusion. When Magnesiumsulphate is administered by intermittent or continuous infusion, the required dose shouldbe added to 50-500ml of compatible IV fluid and mixed thoroughly before being infusedover 20-60 minutes at a rate no greater than 150mg/min.
- Compatible with Normal saline , 5% & 10%Dextrose

5- DOSAGE:-

IV

i- Hypomagnesaemia, atrial arrhythmias and ventricular ectopy
2.5 -5gm IV over 20-60 minutes

ii- Eclampsia
Commence with a loading dose of 5gm of Magnesium Sulphate in 100mls of Normalsaline administered over 20 minutes.
For maintenance infusion add 10 gm to 500mlnormal saline.
Commence infusion at 50ml/hr (approximately 1gm/hr) if the patientweighes <55kg. Commence infusion at 75ml/hr (approximately 1.5gm/hr) if the motherweighs >55kg.
- The target serum magnesium concentration in eclampsia is 2.0-3.0 mmol/L.

iii- Torsades de pointes
2gm over 1-2 minutes followed by 20mmol over 6 hours.

iv- Severe asthma
Boluses of 1-2 gm can be given over 20 minutes or a continuous infusion in 100ml of compatible IV fluid .

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Specific recommendations for dosage in renal failure are not available; however,patients with renal failure are at increased risk of magnesium toxicity (particularly wheninfusions are used) and dose reduction may be required.

7- DOSAGE IN PAEDIATRICS:-

IV

i- Hypomagnesaemia

0.2ml/kg

ii- Asthma

IV magnesium sulphate bolus. Use magnesium sulphate 50 % (500 mg/ml). Give 0.1ml/kg(approx 50mg/kg) over 20 minutes (dilute to 20mls with normal saline and infuse viasyringedriver). Maximum dose 5 mls (2.5 g).

8- CLINICAL PHARMACOLOGY:-

Magnesium is the second most plentiful cation of the intracellular fluids. It is Essentialfor the activity of many enzyme systems and plays an important role with regard toneurochemical transmission and muscular excitability.

9- CONTRAINDICATIONS:-

Heart block (unless pacing wires are present)

10- WARNINGS :-

- Hypermagnesaemia

The principal hazard in parenteral magnesium therapy is the production of Abnormallyhigh levels of magnesium in the plasma. The most immediate danger to life isrespiratory depression. Calcium chloride or calcium gluconate provide an effectiveantidote to life threatening hypermagnesaemia.

- Toxicity in the newborn

When Magnesium Sulphate, is administered intravenously by a continuous infusion forlonger than 24 hours before delivery, the possibility of the baby's showing signs ofneuromuscular or respiratory depression of the newborn should be considered, sincefoetal toxicity can occur.

- A baby with hypermagnesemia my require resuscitation and assisted ventilation.

11- PRECAUTIONS :-

General

Since Magnesium is excreted almost entirely by the kidneys, it should be given Verey cautiously in the presence of serious impairment of renal function.

12-Laboratory Tests:-

Patients with eclampsia treated with magnesium by infusion should have serum magnesium levels measured 6 hourly until stability is achieved. The target serum magnesium concentration in eclampsia is 2.0-3.0 mmol/L.

13-Drug/Laboratory Test Interactions:-

None known.

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

When barbiturates, narcotics, hypnotics (or systemic anaesthetics), or other Centralnervous system depressants are to be given in conjunction with magnesium, theirdosage should be adjusted with caution because of the additive central nervous systemdepressant effects of magnesium.

15- ADVERSE REACTIONS :-

Principal adverse reactions are related to the high plasma levels of magnesium Andinclude flushing, sweating, hypotension, circulatory collapse, and cardiac and Centralnervous system depression. Respiratory depression is the most life-threatening effect.

METHYLETHYLPREDNISOLONE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Solu-Medrol

3- CLINICAL PHARMACOLOGY :-

Methylprednisolone is a potent anti-inflammatory steroid synthesized in a laboratory.Methylprednisolone is a steroid. 1mg methylprednisolone equals 5mg hydrocortisone inglucocorticoid activity and 0.5mg in mineralocorticoid activity

4- ICU INDICATIONS:-

i- Steroid responsive lung diseases

ii- ARDS
iii- Stevens Johnson syndrome

5- PRESENTATION AND ADMINISTRATION:-

- IV

40mg/ml , 125mg/2ml , 500mg/4ml , 1gm (+15.6mlsolv)

Note: there is a depo product (Depo-Medrol); make sure you are using SOLU-Medrol for IV use

- Directions for mixing Act-O-Vial:

Press down on plastic activator. This forces diluent into the lower compartment. Gentlyagitate to dissolve powder. To withdraw solution remove plastic tab covering the centreof stopper. Wipe top of stopper with alcohol swab. Insert needle squarely throughcentre of stopper until tip is just visible. Invert vial and withdraw dose.

- Directions for mixing other vial preparations:

Add 1gm to 15.6ml of supplied diluent provided to make a final 62.5mg/ml. Gently agitate to dissolve powder.

- Doses of up to 250mg can be injected slowly by direct IV injection over at least 5minutes
- Doses of 125mg to 3gm may be diluted in 50ml of compatible IV fluid and Administeredover 30 minutes.
- When reconstituted with water for injection use immediately and discard any Unusedsolution.
- Small volume dilutions (50-100ml) are stable for 6 hours at room temperature.
- Large volume dilutions (250-1000ml) are stable for 24 hours at room temperature.
- Compatible with normal saline, 5% dextrose

6- DOSAGE:-

IV

- Doses vary widely depending in indication. Currently, the best available evidence forARDs suggests dosages of 1-2mg/kg daily are the most appropriate. Doses of up to30mg/kg have been used. For prophylaxis against laryngeal oedema in high riskpatients, the recommended dose is 20mg 4 hourly for 4 doses beginning 12 hours prior to planned extubation.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY: -

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

Doses vary widely depending in indication. Currently, the best available evidence forARDs suggests dosages of 1-2mg/kg daily are the most appropriate. Doses of up to30mg/kg have been used.

9- CONTRAINDICATIONS:-

i- The use of methylprednisolone sodium succinate sterile powder is contraindicated in premature infants because the 40, 125, 500, 1 g, and the

accompanying diluent for the 500 mg and 2 g vials contain benzyl alcohol. Benzylalcohol has been reported to be associated with a fatal "Gasping Syndrome" in premature infants.

ii- Systemic fungal infections
iii- Known hypersensitivity to the product and its constituents.

10- WARNINGS :-

In patients on corticosteroid therapy subjected to any unusual stress, increased Dosage of rapidly acting corticosteroids before, during, and after the stressful situation isindicated.
Corticosteroids may mask some signs of infection, and new infections may appearduring their use.

11- PRECAUTIONS :-

- General
  - Drug-induced secondary adrenocortical insufficiency may be minimized by Gradualreduction of dosage. This type of relative insufficiency may persist for months afterdiscontinuation of therapy; therefore, in any situation of stress occurring during thatperiod, hormone therapy should be reinstituted.
  - Since mineralocorticoid secretion maybe impaired, salt and/or a mineralocorticoid should be administered concurrently.
  - There is an enhanced effect of corticosteroids on patients with hypothyroidism and inthose with cirrhosis.
  - Psychic derangements may appear when corticosteroids are used, ranging from euphoria, insomnia, mood swings, personality changes, and severe depression, to frankpsychotic manifestations. Also, existing emotional instability or psychotic tendenciesmay be aggravated by corticosteroids.
  - An acute myopathy has been observed with the use of high doses of corticosteroids,most often occurring in patients with disorders of neuromuscular transmission (e.g.,myasthenia gravis), or in patients receiving concomitant therapy with neuromuscularblocking drugs (e.g., pancuronium). This acute myopathy is generalized, may involveocular and respiratory muscles, and may result in quadriparesis.
  - Elevations of creatinekinase may occur. Clinical improvement or recovery after stopping corticosteroids mayrequire weeks to years.

12- Laboratory Tests:-

No tests additional to usual ICU tests are required

13- Drug/Laboratory Test Interactions:-

None of note

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Convulsions have been reported with concurrent use of methylprednisolone Andcyclosporin. Drugs that induce hepatic enzymes such as phenobarbital, phenytoin andrifampin may increase the clearance of methylprednisolone and may require increasesin methylprednisolone dose to achieve the desired response.

15- ADVERSE REACTIONS :-

- Fluid and Electrolyte Disturbances
  Sodium retention, potassium loss, fluid retention, hypokalemic alkalosis, Congestiveheart failure in susceptible patients, hypertension.
- Musculoskeletal
  Muscle weakness, aseptic necrosis of femoral and humeral heads, steroid myopathy,loss of muscle mass, pathologic fracture of long bones, severe arthralgia, osteoporosis,vertebral compression fractures, tendon rupture (particularly of the Achilles tendon).
- Gastrointestinal
  Peptic ulcer with possible perforation and haemorrhage, abdominal distention, ulcerative oesophagitis, pancreatitis. Increases in alanine transaminase (ALT, SGPT),aspartate transaminase (AST, SGOT), and alkaline phosphatase have been Observed following corticosteroid treatment. These changes are usually small, not associated withany clinical syndrome and are reversible upon discontinuation.
- Dermatologic
  Impaired wound healing, facial erythema, thin fragile skin, increased sweating, petechiae and ecchymoses, may suppress reactions to skin tests.
- Neurological
  Increased intracranial pressure with papilloedema (pseudo-tumour cerebri) usuallyAfter treatment, convulsions, vertigo, headache.
- Endocrine
  Development of Cushingoid state, menstrual irregularities, suppression of growth Inchildren, decreased carbohydrate tolerance, secondary adrenocortical and Pituitaryunresponsiveness (particularly in times of stress, as in trauma, surgery or illness),manifestations of latent diabetes mellitus, increased requirements for insulin or oralhypoglycaemic agents in diabetics.

MIDAZOLAM :-

1- ADMINISTRATION ROUTES:-

IV, IM, PO

2- CLINICAL PHARMACOLOGY :-

Midazolam is a benzodiazepine. The precise mechanism by which midazolam exerts itsantiseizure effect is unknown, although it is believed to be related to its ability toenhance the activity of gamma aminobutyric acid (GABA), the major inhibitoryneurotransmitter in the central nervous system.

3- ICU INDICATIONS:-

i- Sedation
ii- Treatment of seizures

4- PRESENTATION AND ADMINISTRATION:-

- IV

15mg/3ml vial and 5mg/5ml vial
- For direct IV injection, usually diluted to a concentration of 1mg/ml using compatible IVfluid and injected slowly.
- For continuous infusion dilute 60mg up to a total of 60ml with compatible IV fluid
- Compatible with Normal saline 5% dextrose 10% dextroseHartmanns
Any solutions not used within 24 hours should be discardedStore at room temperature. Do not freeze.
- IM
Inject undiluted into a large muscle mass

5- DOSAGE:-

- IM
Sedation: 1-5mg
- IV
Sedation: 1-10mg
Infusion: 0-20mg/hr
- PO
Premed: 7.5-15mg

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
<10 - 50% of normal dose
10-20 - dose as in normal renal function
>20-50 - dose as in normal renal function

- Dose in renal replacement therapy
CAPD - 50% of normal dose
HD - 50% of normal dose

7- DOSAGE IN PAEDIATRICS:-

- IM
Sedation: usually 0.1-0.5mg/kg.
- IV
Sedation: usually 0.1-0.5mg/kg.
Infusion (ventilated): Dilute 3mg/kg in 50ml 5% dextrose and run at 0-5ml/hr (0-5mcg/kg/min)
- Intranasal
Sedation: 0.2mg/kg nasal (repeated in 10 minutes if required)
- PO
Sedation: 0.5mg/kg (max 20mg)

8- CONTRAINDICATIONS:-

Hypersensitivity to benzodiazepines

9- WARNINGS :-

Withdrawal symptoms of the barbiturate type have occurred after the discontinuation ofbenzodiazepines including midazolam

10- PRECAUTIONS :-

General

Hypoventilation, airway obstruction, and apnoea can lead to hypoxia and/or Cardiacarrest unless effective countermeasures are taken immediately.

11- Laboratory Tests:-

No tests in addition to routine ICU tests are indicated

12- Drug/Laboratory Test Interactions:-

None noted

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

The CNS-depressant action of the benzodiazepine class of drugs may be potentiated byalcohol, narcotics, barbiturates, nonbarbiturate hypnotics, antianxiety agents, the phenothiazines, thioxanthene and butyrophenone classes of antipsychotic agents,monoamine oxidase inhibitors and the tricyclic antidepressants, and by otheranticonvulsant drugs.

14- ADVERSE REACTIONS :-

- Neurologic

  Abnormal eye movements, aphonia, choreiform movements, coma, diplopia, dysarthria,dysdiadochokinesis, 'glassy-eyed' appearance, headache, hypotonia, nystagmus,respiratory depression, slurred speech, tremor, vertigo.

- Psychiatric

  Confusion, depression, amnesia, hallucinations, hysteria, increased libido, insomnia,psychosis, suicidal attempt. The following paradoxical reactions have been observed:Excitability, irritability, aggressive behavior, agitation, nervousness, hostility, anxiety,sleep disturbances, nightmares and vivid dreams.

- Respiratory

  Apnoea, hypoventilation

- Cardiovascular

  Palpitations, hypotension.

- Hematopoietic

  Anaemia, leukopaenia, thrombocytopaenia, eosinophilia.

- Hepatic

  Hepatomegaly, transient elevations of serum transaminases and alkaline phosphatase.

MILRINONE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Primacor

3- CLINICAL PHARMACOLOGY:-

- Milrinone lactate is a positive inotrope and vasodilator, with little chronotropic Activity different in structure and mode of action from either the digitalis glycosides or catecholamines.
- Milrinone lactate, at relevant inotropic and vasorelaxant concentrations, is a Selective inhibitor of peak III cAMP phosphodiesterase isozyme in cardiac and vascular muscle.This inhibitory action is consistent with cAMP mediated increases in intracellular ionized calcium and contractile force in cardiac muscle, as well as with cAMP dependent contractile protein phosphorylation and relaxation in vascular muscle.

4- ICU INDICATIONS:-

Low cardiac output states due to impaired myocardial contractility

5- PRESENTATION AND ADMINISTRATION:-

- Milrinone 1mg/ml (10ml vial)
- Dilute 10mg up to 50ml using compatible IV fluid
- Compatible With 0.9% saline , 5% dextrose
- Store at room temperature
- Preparations not used in 24 hours should be discarded

6- DOSAGE:-

- IV infusion

0.375-0.75mcg/kg/min

Note:- a loading dose of up to 50mcg/kg may be used but is not used in our ICU due tothe risk of hypotension; patients may receive a loading dose in theatre prior to coming ofbypass.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]

<10 - usual dose 0.2mcg/kg/min
10-40 - usual dose 0.3mcg/kg/min
>40-50 - usual dose 0.4mcg/kg/min

- Dose in renal replacement therapy

CAPD - usual dose 0.2mcg/kg/min
HD - usual dose 0.2mcg/kg/min

Note: renal impairment significantly increases the terminal elimination half life of milrinone. Patients with renal impairment on milrinone infusions may develop progressive vasodilation leading to escalating noradrenaline requirements. If noradrenaline requirement is increasing consider whether it is appropriate to ceasemilrinone.

8- DOSAGE IN PAEDIATRICS:-

- IV infusion
- <30kg: 1.5mg/kg in 50ml 5% dextrose at 0.5-1.5ml/hr (0.25 0.75mcg/kg/min)
- >30kg: 1.5mg/kg in 100ml 5% dextrose a 1-3ml/hr (0.25-0.75mcg/kg/min)

9- CONTRAINDICATIONS:-

Hypersensitivity to milrinone

10- WARNINGS :-

Milrinone is an inodilator. Significant hypotension due to peripheral vasodilation Is common and is generally treated with noradrenaline.

11- PRECAUTIONS :-

General

The use of milrinone has been associated with increased frequency of ventricular andatrial arrhythmias.

Milrinone may aggravate outflow tract obstruction in hypertrophic subaortic stenosis.

12- Laboratory Tests -:

No tests in addition to routine ICU tests are indicated

13- Drug/Laboratory Test Interactions:-

None noted

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

None of note.

15- ADVERSE REACTIONS :-

- Cardiovascular
  SVT, VT, VF, hypotension
- Respiratory
  bronchospasm
- CNS
  Headaches, tremor.
- Haematological
  Thrombocytopaenia
- Metabolic
  Hypokalaemia

MORPHINE SULPHATE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

RA morph (morphine hydrochloride), LA morph, m-Eslon, Sevredol

3-CLINICAL PHARMACOLOGY :-

Morphine, a pure opiate agonist

4- ICU INDICATIONS:-

i- Analgesia
ii- Sedation

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - Morphine sulphate 10mg/1ml and 30mg/1ml vial; also, comes in 50mg in 50ml Prefilled syringes. Also available, morphine tartrate 120mg in 1.5ml (used primary to make upmorphine PCAs in double strength – i.e. 120mg in 60ml)
  - For direct injection, the usual method is to dilute 10mg into a total of 10ml of
  - Compatible IV fluid For infusion, use prefilled syringes or dilute with compatible IV fluid to a dilution of 1mg/ml

- Compatible in :Normal saline 5% dextrose Hartmanns Glucose andsodium chloride
- Store at room temperature. Protect from light.
- Store in controlled drug safe.

- PO
  - Tablets
    Sevredol 10mg tablets , Sevredol 20mg tablets
  - Sustained Release Tablets
    LA Morph 10mg tablets , LA Morph 30mg tablets , LA Morph 60mg tablets , LA Morph 100mg tablets
  - Sustained Release Capsules
    M-Eslon 10mg , M-Eslon 30mg , M-Eslon 60mg, M-Eslon 100mg

6- DOSAGE

- PO
  Initially 5-20 mg every 4 hours of sevredol.
  Sustained release formulations are administered 12 hourly
- IV
  - Analgesia: usually 1-5mg PRN
  - Infusion: 0-20mg/hr
  - PCA(Patient-controlled analgesia): usually 1mg with 5 minute lock-out and maximum of 12mg/hr

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  <10 - use small doses (e.g. 1mg)
  10-20 - use small doses (e.g. 2mg)
  >20-50 - 75% of normal
- Dose in renal replacement therapy
  CAPD - use small doses (e.g. 1mg)
  HD - use small doses (e.g. 1mg)

Note: usually fentanyl is used in preference to morphine where there is significant renal Impairment

8- DOSAGE IN PAEDIATRICS:-

- IM
  0.1-0.2mg/kg
- IV
  - 0.05-0.1mg/kg by slow incremental injection over 5 to 15 minutes.
  - If ventilated, 0.1-0.2mg/kg/dose.
- IV infusion
  1mg/kg in 50ml 5% dextrose at 0-4ml/hr (0-80mcg/kg/hr)
- PCA
  PCA 20mcg/kg boluses (1ml of 1mg/kg in 50ml) with 5 minute lock-out time

9- CONTRAINDICATIONS:-

Hypersensitivity to morphine

10- WARNINGS :-

- Impaired Respiration

Respiratory depression is the chief hazard of all morphine preparations. Respiratorydepression occurs most frequently in the elderly and debilitated patients as well as inthose suffering from conditions accompanied by hypoxia or hypercapnia when evenmoderate therapeutic doses may dangerously decrease pulmonary ventilation.Morphine should be used with extreme caution in patients with chronic obstructivepulmonary disease or cor pulmonale, and in patients having a substantially decreased respiratory reserve, hypoxia, hypercapnia, or preexisting respiratory depression. In suchpatients, even usual therapeutic doses of morphine may decrease respiratory drivewhile simultaneously increasing airway resistance to the point of apnea.

- Hypotensive Effect

Morphine sulphate controlled-release tablets, like all opioid analgesics, may Causesevere hypotension in an individual whose ability to maintain his blood pressure hasalready been compromised by a depleted blood volume, or a concurrent administrationof drugs that lower blood pressure.

- Anaphylaxis

Although extremely rare, cases of anaphylaxis have been reported.

11- PRECAUTIONS :-

General

Morphine may aggravate pre-existing convulsions in patients with convulsive disorders.

12- Laboratory Tests:-

No tests in addition to routine ICU tests are indicated

13- Drug/Laboratory Test Interactions:-

None noted

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

The concomitant use of other central nervous system depressants including Sedatives or hypnotics, general anaesthetics, phenothiazines, tranquilizers, and alcohol mayproduce additive depressant effects. Respiratory depression, hypotension, and profound sedation or coma may occur.

15- ADVERSE REACTIONS :-

- Central Nervous System

Weakness, headache, agitation, tremor, uncoordinated muscle movements, seizure,alterations of mood (nervousness, apprehension, depression, floating feelings), dreams,muscle rigidity, transient hallucinations and disorientation, visual disturbances,insomnia.

- Respiratory

Respiratory depression, apnoea, respiratory arrest,

- Gastrointestinal

Dry mouth, biliary tract spasm, laryngospasm, anorexia, diarrhoea, cramps, Tastealteration, constipation, ileus, intestinal obstruction, increases in

hepatic enzymes.

- Cardiovascular

  Flushing of the face, chills, tachycardia, bradycardia, palpitation, faintness, syncope,hypotension, hypertension.

- Genitourinary

  Urine retention or hesitance, reduced libido and/or potency.

- Dermatologic

  Pruritus, urticaria, other skin rashes, oedema, diaphoresis.

NALOXONE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Narcan

3-CLINICAL PHARMACOLOGY:-

Naloxone hydrochloride, is a narcotic antagonist. Naloxone prevents or reverses the effects of opioids including respiratory depression, sedation and hypotension.

4- ICU INDICATIONS:-

Reversal of narcotic respiratory depression and coma

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 0.4mg in 1ml vial
  - For bolus injection, usually dilute one vial in 10-20ml of compatible IV fluid
  - For continuous infusion, add 2mg to 500ml of compatible IV fluid to give a solution witha concentration of 4mcg/ml.
  - Discard any solution not used within 24 hours of preparation
  - Compatible with Normal saline 5% dextrose Water for injection
  - Store at room temperature

6- DOSAGE:-

- IV
  - For reversal of post-operative respiratory depression and coma: 20-40mcg IV PRN
  - For opioid overdose: 40-400mcg IV PRN
  - Infusion: If an infusion is required, commence the infusion with an hourly infusion Ratecalculated as 2/3rd of the total bolus dose given to achieve the desired opioid reversaleffect

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

- IV
  - For post-operative respiratory depression or over-sedation, give 0.002mg/kg/dose (i.e.dilute 0.4mg to 20ml and then give 0.1ml/kg/dose).
  - Repeat every 2 minutes x4 ifrequired, then commence infusion by adding 0.3mg/kg to 30ml 5% dextrose andrunning at 0-1ml/hr (0.01mg/kg/hr).

  - For opiate overdose, give 0.01mg/kg (max 0.4mg) (i.e. dilute 0.4mg to 10ml and give0.25ml/kg/dose). Repeat every 2 minutes x4 if required, then commence infusion byadding 0.3mg/kg to 30ml 5% dextrose and running at 0-1ml/hr (0.01mg/kg/hr).

9- CONTRAINDICATIONS:-

Hypersensitivity to naloxone

10- WARNINGS

- Naloxone injection should be administered cautiously to persons including newborns ofmothers who are known or suspected to be physically dependent on opioids. In suchcases, an abrupt and complete reversal of narcotic effects may precipitate an acuteabstinence syndrome.
- Naloxone is not effective against respiratory depression due to non-opioid drugs.

11- PRECAUTIONS :-

General

In addition to naloxone injection, other resuscitative measures, such as maintenance ofa free airway, artificial ventilation, cardiac massage and vasopressor agents should beavailable and employed, when necessary, to counteract acute narcotic poisoning.

Several instances of hypotension, hypertension, ventricular tachycardia and fibrillation,and pulmonary edema have been reported. These have occurred in postoperativepatients most of whom had pre-existing cardiovascular disorders or received otherdrugs which may have similar adverse cardiovascular effects. Although a direct causeand effect relationship has not been established, naloxone injection should be used withcaution in patients with pre-existing cardiac disease or patients who have receivedpotentially cardiotoxic drugs.

12- Laboratory Tests:-

No tests in addition to usual ICU tests are indicated

13- Drug/Laboratory Test Interactions:-

None of note

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Reverses opioid effects

15- ADVERSE REACTIONS :-

Abrupt reversal of narcotic depression may result in nausea, vomiting, sweating,tachycardia, increased blood pressure and tremulousness.
In post-operative patients,larger than necessary dosages of naloxone may result in significant reversal ofanalgesia.
Hypotension, hypertension, ventricular tachycardia and fibrillation, and Pulmonaryoedema have been associated with the use of naloxone postoperatively

NEOSTIGMINE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Neostigmine

3- CLINICAL PHARMACOLOGY :-

Neostigmine inhibits the hydrolysis of acetylcholine by competing with acetylcholine forattachment to acetylcholinesterase at sites of cholinergic transmission. It enhancescholinergic action by facilitating the transmission of impulses across neuromuscularjunctions.

4-ICU INDICATIONS:-

i- Reversal of neuromuscular blockade
ii- Ileus

5- PRESENTATION AND ADMINISTRATION:-

IV

- 2.5mg in 1ml vial
- For reversal of neuromuscular blockade administer with either atropine or glycopyrrolate
- For ileus, add 2.5mg to 100ml of compatible IV fluid and administer over 5 hours
- Compatible with Normal saline and 5% dextrose
- Store at room temperature

6- DOSAGE:-

IV

- For reversal of neuromuscular blockade, use 2.5mg of neostigmine with 0.6-1.2mg ofatropine
- For treatment of ileus give 2.5mg neostigmine over no less than 5 hours

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

- IV
  - For reversal of neuromuscular blockade, add 1.25mg (0.5ml) of neostigmine + 0.3mg(0.5ml) of atropine + 0.5ml of normal saline and then give 0.1ml/kg IV

Note: do not use as a treatment for ileus in children due to high risk of Symptomatic bradycardia or asystole.

9- CONTRAINDICATIONS:-

i- Hypersensitivity to neostigmine

ii- Mechanical obstruction of the gastrointestinal tract

10- WARNINGS :-

Neostigmine can cause severe bradycardia and even asystole

11- PRECAUTIONS :-

- General

  Neostigmine methylsulfate should be used with caution in patients with epilepsy, bronchial asthma, bradycardia, recent coronary occlusion, vagotonia, hyperthyroidism,cardiac arrhythmias or peptic ulcer.

12-Laboratory Tests:-

No tests in addition to usual ICU tests are indicated

13- Drug/Laboratory Test Interactions:-

None of note

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

Neostigmine methylsulfate does not antagonize, and may in fact prolong, the Phase I block of depolarizing muscle relaxants such as succinylcholine.

15- ADVERSE REACTIONS :-

- Body as a Whole

  Anaphylaxis.
- Neurologic

  Dizziness, convulsions, loss of consciousness, drowsiness, headache, dysarthria, miosis and visual changes.
- Cardiovascular

  Cardiac arrhythmias (including bradycardia, tachycardia, A-V block and nodal rhythm), cardiac arrest, syncope and hypotension.

- Respiratory
  Increased oral, pharyngeal and bronchial secretions, dyspnea, respiratory depression,respiratory arrest and bronchospasm.
- Dermatologic
  Rash and urticaria.
- Gastrointestinal
  Nausea, salivation, cramp, emesis, diarrhoea, flatulence and increased peristalsis.
- Genitourinary
  Urinary frequency.
- Musculoskeletal
  Muscle cramps and spasms, arthralgia.
- Miscellaneous
  Diaphoresis, flushing and weakness.

NIMODIPINE :-

1- ADMINISTRATION ROUTES:-

PO, IV

2- ALTERNATIVE NAMES:-

Nimotop

3- CLINICAL PHARMACOLOGY:-

Nimodipine is a calcium channel blocker which has been shown to improve Outcomeafter subarachnoid haemorrhage

4- ICU INDICATIONS:-

Prophylaxis and treatment of cerebral vasospasm after aneursymal subarachnoid Haemorrhage

5- PRESENTATION AND ADMINISTRATION:-

i- IV

- Nimotop infusion solution: 10mg nimodipine / 50ml
  Use only infusion pumps with polyethylene (PE) infusion tubing, polypropylene (PP)syringes and polyethylene or polypropylene extensions, taps and connectors. Do notuse polyvinylchloride (PVC) infusion tubing as nimodipine is absorbed by the tubing.
  Give via a three-way stopcock with a coinfusion ofcompatible IV fluid in a ratio of 1:4 (nimodipine: coinfusion). For example, an infusionrunning at 10ml/hr requires a co-infusion of 40ml/hr.
- Compatible with Normal saline ,5% dextrose , Mannitol 10% AND 5% albumin
- Store at room.
- Protect from light. Infusion solution is light sensitive. Do not use in direct sunlight.

Note:- administration of nimodipine via a central line is preferred as nimodipine Causesthrombophlebitis when administered peripherally. If necessary, the peripheral route canbe used (although administration via this route is not licensed)

ii- PO

Nimotop tablets 30mg

6- DOSAGE:-

i- IV

- Commence infusion at 1mg/hr (5ml/hr) for two hours and then increase to 2mg/hr (10ml/hr) if tolerated. For patients who are unable to tolerate infusion at 1mg/hr, commenceinfusion at 0.5mg/hr (2.5ml/hr)
- Weaning from IV to oral therapy:
  Commence regular oral therapy . After the first dose of nimodipine is given, reduce infusion by 1 mL every hour for 5 hours, then cease infusion.
  If the patientbecomes hypotensive after oral nimodipine is given, cease the infusion immediately.Observe for neurological deterioration. If the patient does deteriorate neurologically,cease weaning off IV nimodipine and return to full IV therapy.

ii- PO

60mg 4 hourly for 21 days; if not tolerated due to hypotension, try a reduced dose of30mg 4 hourly.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

10-15mcg/kg/hr IV for 2 hours then 10-45mcg/kg/hr

9-CONTRAINDICATIONS:-

Hypersensitivity to nimodipine

10- WARNINGS :-

Nimodipine can cause hypotension. If hypertensive therapy is being pursued or thepatient develops significant hypotension during nimodipine treatment, the dose shouldbe reduced or nimodipine should be withheld.

11- PRECAUTIONS :-

General

The metabolism of nimodipine is decreased in patients with impaired hepatic function.Such patients should have their blood pressure and pulse rate monitored closely andshould be given a lower dose.(usually 50% of normal dose)

12- Laboratory Tests:-

No tests in addition to usual ICU tests are indicated

13- Drug/Laboratory Test Interactions:

None of note

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

The risk of hypotension increases with concomitant administration of other antihypertensive drugs.

15- ADVERSE REACTIONS

- Cardiovascular
  Hypotension, tachycardia, bradycardia
- Respiratory
  Dyspnoea
- Gastrointestinal
  Nausea, dyspepsia, deranged liver function tests, diarrhoea
- Neurological
  Headache

NORADRENALINE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Levophed

3- CLINICAL PHARMACOLOGY:-

Norepinephrine bitartrate functions as a peripheral vasoconstrictor (alpha-Adrenergicaction) and as an inotropic stimulator of the heart and dilator of coronary arteries(betaadrenergicaction). The alpha action predominates.

4- ICU INDICATIONS:-

i- Septic shock
ii- Other distributive shock

5- PRESENTATION AND ADMINISTRATION:-

IV

- Use 10mg in 100ml (0.1mg/ml) pre-mixed bags; 2mg in 2ml vials (1:1000) can be usedto make up double strength noradrenaline if required by adding 20mg of noradrenalineto 100ml of compatible IV fluid.
- Compatible with 5% dextrose , sodium chloride
- Store at room temperature

6- DOSAGE:-

IV

0-20ml/hr (higher doses may occasionally be required)

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:

No dosage adjustment is required

8- DOSAGE IN PAEDIATRICS:-

IV Infusion

0.3mg/kg in 50ml D5W at 0.5-10ml/hr (equates to 0.05-1mcg/kg/min)

9- CONTRAINDICATIONS:-

Nil

10- WARNINGS :-

Norepinephrine injection contains sodium metabisulfite, a sulfite that may Causeallergic-type reactions including anaphylactic symptoms and life-threatening or lesssevere asthmatic episodes in certain susceptible people.

11- PRECAUTIONS :-

- General

Norepinephrine should not be given to patients who are hypotensive from blood volumedeficits except as an emergency measure to maintain coronary and cerebral arteryperfusion until blood volume replacement therapy can be completed.

12- Laboratory Tests:-

No tests additional to routine ICU tests are required.

13- Drug/Laboratory Test Interactions

None reported

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

None of note

15- ADVERSE REACTIONS

- Body as a Whole

Ischemic injury due to potent vasoconstrictor action tissue hypoxia.

- Cardiovascular System

Bradycardia, probably as a reflex result of a rise in blood pressure, arrhythmias.

- Nervous System

Anxiety, transient headache.

OCTREOTIDE :-

1- ADMINISTRATION ROUTES:

SC, IV

2- ALTERNATIVE NAMES:

Sandostatin

3- CLINICAL PHARMACOLOGY:

Octreotide exerts pharmacologic actions similar to the natural hormone somatostatin. Itis an even more potent inhibitor of growth hormone, glucagon, and insulin thansomatostatin. Like somatostatin, it also suppresses LH response to GnRH, decreasessplanchnic blood flow, and inhibits release of serotonin, gastrin, vasoactive intestinalpeptide, secretin, motilin, and pancreatic polypeptide.

4- ICU INDICATIONS:

i- variceal bleeding
ii- chylothorax
iii- carcinoid tumours, VIPomas and acromegally

5- PRESENTATION AND ADMINISTRATION:

- SC

  Inject the required dose as undiluted solution by subcutaneous injection. Allow solutionto come to room temperature to minimize pain at the injection site.

- IV
  - 50mcg/ml, 100mcg/ml and 500mcg/ml vials
  - For continuous infusion dilute 500mcg vial in 50ml of normal saline
  - Dilutions stable for 24 hours at room temperature
  - Refrigerate vials for prolonged storage; may be stored at room temperature for up totwo weeks. Protect from light.

6- DOSAGE:

- SC

  Chylothorax: 100mcg 8 hourly

- IV

  When commencing an octreotide infusion, start with 50mcg SC undiluted stat then run infusion at 25mcg/hr.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:

No dosage adjustment is required

8-DOSAGE IN PAEDIATRICS:

Diarrhoea secondary to endocrine tumours:1 mcg/kg stat then 1-5mcg/kg/kg IV

9- CONTRAINDICATIONS:

sensitivity to octreotide

10- WARNINGS

Octreotide inhibits gallbladder contractility and may predispose to biliary tract Diseasesuch as cholecystitis and ascending cholangitis.

11- PRECAUTION

Nil

12- Laboratory Tests:

Baseline thyroid function tests should be performed for people who require Chronictherapy (although such patients are extremely rare in ICU)

13- Drug/Laboratory Test Interactions

None reported

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

Concomitant administration of Octreotide with cyclosporin may decrease blood levels of cyclosporin and result in transplant rejection.

Patients receiving insulin, oral hypoglycaemic agents, beta blockers, calcium Channel blockers, or agents to control fluid and electrolyte balance, may require dose adjustments of these therapeutic agents.

15- ADVERSE REACTIONS

- Gastrointestinal

  Diarrhoea, vomiting, abdominal distention, constipation, biliary sludge, gallstones,nausea and abdominal discomfort

- Cardiac

  bradycardia

- Metabolic and endocrine

  Hypoglycaemia, hyperglycaemia, hypothyroidism

- Neurological

  headache

OLANZAPINE :-

1-ADMINISTRATION ROUTES:-

PO, IM, NG

2-ALTERNATIVE NAMES:-

Zyprexa

3- CLINICAL PHARMACOLOGY:-

Olanzapine is a selective monoaminergic antagonist. The mechanism of action Ofolanzapine is unknown; however, it has been proposed that this drug's efficacy ismediated through a combination of dopamine and serotonin type 2 (5HT2) antagonism.

4- ICU INDICATIONS:-

i- Agitation and delirium

ii- Psychosis

5-PRESENTATION AND ADMINISTRATION:-

- IM

Zyprexa IM 10mg. Reconstitute with 2.1ml of sterile water for injection and Administerby IM injection.

- PO / NG

Zyprexa 2.5mg tablets , Zyprexa 5mg tablets, Zyprexa 10mg tablets

Note: for NG administration, dissolve wafers and give via NG tube

6- DOSAGE:-

- IM

Initially 5-10mg; may administer an additional dose of up to 10mg after 2 hours and afurther dose of up to 10mg 4 hours after the second dose (max dose 30mg / 24 hours)

- PO

5-20mg daily (can be administered in divided doses)

7-DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]

<10 - initial dose of 5mg and titrate as necessary

10-20 - initial dose of 5mg and titrate as necessary

>20-50 - initial dose of 5mg and titrate as necessary
- Dose in renal replacement therapy
CAPD - initial dose of 5mg and titrate as necessary
HD - initial dose of 5mg and titrate as necessary

8- DOSAGE IN PAEDIATRICS:-

0.1-0.2mg/kg daily oral; increase to 0.4mg/kg daily oral if required

9- CONTRAINDICATIONS:

Sensitivity to olanzapine

10-WARNINGS

- Increased risk of deaths in patients with dementia
Elderly patients with dementia-related psychosis treated with atypical Antipsychoticdrugs are at an increased risk of death compared to placebo.
- Hyperglycaemia and Diabetes Mellitus
Hyperglycaemia, in some cases extreme and associated with ketoacidosis or hyperosmolar coma or death, has been reported in patients treated with atypical antipsychotics including olanzapine.
- Neuroleptic Malignant Syndrome (NMS)
A potentially fatal symptom complex sometimes referred to as Neuroleptic Malignant Syndrome (NMS) has been reported in association with administration of antipsychoticdrugs, including olanzapine.
- Tardive Dyskinesia
A syndrome of potentially irreversible, involuntary, dyskinetic movements may Developin patients treated with antipsychotic drugs.

11-PRECAUTIONS

- General
Olanzapine may induce hypotension. Olanzapine has not been evaluated or used toany appreciable extent in patients with a recent history of myocardial infarction or unstable heart disease. Patients with these diagnoses were excluded from premarketing clinical studies. Because of the risk of orthostatic hypotension with olanzapine, cautionshould be observed in cardiac patients
During premarketing testing, seizures occurred in 0.9%. Olanzapine should be Used cautiously in patients with a history of seizures or with conditions that potentially lower the seizure threshold

12-Laboratory Tests:

No tests additional to routine ICU tests are indicated

13-Drug/Laboratory Test Interactions

None reported

14-IMPORTANT DRUG INTERACTIONS FOR THE ICU

Because of its potential for inducing hypotension, olanzapine may enhance the Effects of antihypertensive agents.

15-ADVERSE REACTIONS

- Body as a Whole

Fever
- Cardiovascular System
Hypotension, Tachycardia, Hypertension
- Digestive System
Dry mouth, Constipation, Dyspepsia, Vomiting
- Nervous System
Dizziness, Tremor, Hypertonia

ONDANSETRON :-

1-ADMINISTRATION ROUTES:-

PO, IV, IM

2-ALTERNATIVE NAMES:-

Zofran

3- ICU INDICATIONS:-

Nausea and vomiting

4- CLINICAL PHARMACOLOGY:-

- Ondansetron is a selective 5-HT3 receptor antagonist. While ondansetron's Mechanism of action has not been fully characterised, it is not a dopamine-receptor antagonist.
- Serotonin receptors of the 5-HT3 type are present both peripherally on vagal nerve terminals and centrally in the chemoreceptor trigger zone of the area postrema. It is notcertain whether ondansetron's antiemetic action in chemotherapy-induced nausea andvomiting is mediated centrally, peripherally, or in both sites.

5- PRESENTATION AND ADMINISTRATION:-

i- IV
- Ondansetron 4mg/2ml and 8mg/4ml
- Doses of up to 8mg can be administered undiluted by slow IV injection over 2 to 5 minutes
- Doses of 8mg to 32mg, which are rarely if every administered in ICU, should be dilutedin 50-100ml of compatible IV fluid and infused over 15 minutes or more.
- Compatible with Normal saline , 5% dextrose , mannitol
- Store at room temperature. Protect from light

ii- IM
- Inject undiluted into a large muscle (this route is not routinely used in ICU)

iii- PO
- Tablets
Zofran 4mg and 8 mg tablets
- Dispersible tablets
Zofran zydis 4mg and 8mg tablets

6- DOSAGE:-

- IV

4-8mg 6 hourly

- PO

4-8mg 6 hourly

7-DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

0.2mg/kg 6-12 hourly

9- CONTRAINDICATIONS:-

Hypersensitivity to ondansetron

10- WARNINGS :-

Nil

11-PRECAUTIONS :-

Nil

12-Laboratory Tests:-

No tests additional to routine ICU tests are indicated

13-Drug/Laboratory Test Interactions :-

None reported

14-IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

None of note

154-ADVERSE REACTIONS

- Body as a Whole

Rash, anaphylaxis

- Cardiovascular

Hypotension, tachycardia, flushing

- Gastrointestinal

Constipation, elevated transaminases

- Neurological

Headache

PARACETAMOL :-

1-ADMINISTRATION ROUTES:-

PO, IV, PR

2-ALTERNATIVE NAMES:-

Pamol, Panadol, Perfalgan

3-CLINICAL PHARMACOLOGY:-

Paracetamol is analgesic and antipyretic. The precise mechanism of the analgesic and antipyretic properties of paracetamol has yet to be established; it may involve centraland peripheral actions.

4- ICU INDICATIONS:-

i- Analgesia
ii- Antipyretic

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - Perfalgan 10mg/mL solution contains 1gm of paracetamol in 100ml. Can also be diluted in compatible IV fluid. In this case, use the diluted solution within the hour following its preparation (infusion time included).
  - Compatible with Normal saline and 5% dextrose

    As for all solution for infusion presented in glass vials, it should be remembered that close monitoring is needed notably at the end of the infusion, regardless of theadministration route. This monitoring at the end of the perfusion applies particularly forcentral route infusion, in order to avoid air embolism. It is recommended that for the administration of Perfalgan 10mg/mL solution for infusiona syringe or giving set with a diameter equal to or below 0.8mm should be used forsolution sampling.

    In addition, it is recommended that the bung is pierced at the location specifically designed for needle introduction (where the thickness of the bung isthe lowest). If these recommendations are not adhered to the likelihood of bungfragmentation or the bung being forced into the vial is increased.
  - Store at room temperature
- PO

  Available in 500mg capsules, tablets, soluble tablets and suppositories

6-DOSAGE:-

- IV

1gm 4 hourly (maximum 4gm/24 hours)

- PO/PR

1gm 4 hourly (maximum 4gm/24 hours)

Note: In patients with chronic or active hepatic disease, especially those with hepatocellular insufficiency, chronic alcoholism, chronic malnutrition (low reserves of hepatic glutathione), and dehydration the dose should not exceed 3g/day.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8-DOSAGE IN PAEDIATRICS:-

- PO / IV

20mg/kg stat, then 15mg/kg 4 hourly; usual daily maximum of 90mg/kg for 48 Hours then 60mg/kg.

- PR

40mg/kg stat then 30mg/kg 6 hourly (max 5gm/day)

9- CONTRAINDICATIONS:-

1. Hypersensitivity to paracetamol
2. Fulminant hepatic failure

10- WARNINGS

Patients with hepatic insufficiency, chronic alcoholism, chronic malnutrition or dehydration may be at a higher risk of liver damage following administration of paracetamol

11-PRECAUTIONS :-

- General

Paracetamol should be used with caution in the following settings: Glucose 6 Phosphate Dehydrogenase (G6PD) deficiency (may lead to Haemolytic anaemia), chronic alcoholism, excessive alcohol intake (3 or more alcoholic drinks every day), anorexia, bulimia or cachexia, chronic malnutrition (low reserves of hepatic glutathione)

12 -Laboratory Tests:-

No tests indicated in addition to routine ICU tests

13-Drug/Laboratory Test Interactions :-

None known

14-IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

None of note

15-ADVERSE REACTIONS :-

- Neurological

Dizziness, headache, dystonia

- Gastrointestinal

Vomiting, dry mouth, diarrhoea, constipation, nausea, dyspepsia, enlarged

abdomen,transaminitis
- Haematological

PETHIDINE :-

1-ADMINISTRATION ROUTES:-

IV, IM, PO

2-ALTERNATIVE NAMES:-

Meperidine

3- CLINICAL PHARMACOLOGY:-

Pethidine is a narcotic analgesic with multiple actions qualitatively similar to those of morphine; the most prominent of these involve the central nervous system and organscomposed of smooth muscle. The principal actions of therapeutic value are analgesia and sedation.

4- ICU INDICATIONS:-

i- Analgesia
ii- Shivering

5- PRESENTATION AND ADMINISTRATION:-

i- IV
- Pethidine 100mg in 2ml 50mg in 1ml vial.
- Dilute solution to 10mg/ml with Water for Injection.
- Inject slowly over 3-5 minutes (donot exceed 50mg per dose when administering via this route)
- Compatible with 0.9% sodium chloride ad 10% Glucose .
- Store at room temperature

ii- IM

Preferred route for repeated or large doses (as it is less irritating than IV)

iii- PO

-Tablets

Pethidine 50mg tablets , Pethidine 100mg tablets .

6-DOSAGE:-

- IV

Usually 25-50mg IV 4 hourly (rare for more than a single dose to be used in the ICU setting)

7-DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

i- Dose in renal impairment [GFR (ml/min)]
- <10 avoid
- 10-20 use small doses; increase dosing interval to 6 hours.
- >20-50 dose as in normal renal function

ii- Dose in renal replacement therapy
- CAPD avoid
- HD avoid

8-DOSAGE IN PAEDIATRICS:-

- IM
  0.5-2mg/kg 4 hourly
- IV
  0.5-1mg/kg 4 hourly

9- CONTRAINDICATIONS:-

Hypersensitivity to pethidine

10- WARNINGS :-

i- Impaired Respiration
- Respiratory depression is the chief hazard of all opioids. Respiratory depression occurs most frequently in the elderly and debilitated patients as well as in those suffering from conditions accompanied by hypoxia or hypercapnia when even moderate therapeutic doses may dangerously decrease pulmonary ventilation.
- Pethidine should be used with extreme caution in patients with chronic obstructive pulmonary disease or cor pulmonale, and in patients having a substantially decreased respiratory reserve, hypoxia, hypercapnia, or preexisting respiratory depression.
- In such patients, even usual therapeutic doses of morphine may decrease respiratory drive while simultaneously increasing airway resistance to the point of apnoea.

ii- Hypotensive Effect

Morphine sulphate controlled-release tablets, like all opioid analgesics, may cause severe hypotension in an individual whose ability to maintain his blood pressure has already been compromised by a depleted blood volume, or a concurrent administration of drugs that lower blood pressure.

iii- Anaphylaxis

Although extremely rare, cases of anaphylaxis have been reported.

11-PRECAUTIONS :-

General
- Supraventricular Tachycardias
  Pethidine should be used with caution in patients with atrial flutter and other supraventricular tachycardias because of a possible vagolytic action which may produce a significant increase in the ventricular response rate.
- Convulsions
  Pethidine may aggravate pre-existing convulsions in patients with convulsive disorders. If dosage is escalated substantially above recommended levels because of tolerancedevelopment, convulsions may occur in individuals without a history of convulsivedisorders.

12-Laboratory Tests:-

No tests in addition to routine ICU tests are indicated

13-Drug/Laboratory Test Interactions:-

None noted

14-IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

The concomitant use of other central nervous system depressants including sedatives or hypnotics, general anaesthetics, phenothiazines, tranquilizers, and alcohol may produce additive depressant effects. Respiratory depression, hypotension, and profound sedation or coma may occur.

15-ADVERSE REACTIONS :-

- Central Nervous System

  Euphoria, sedation, dysphoria, weakness, headache, agitation, tremor, Uncoordinated muscle movements, severe convulsions, transient hallucinations and disorientation,visual disturbances.

- Gastrointestinal

  Nausea and vomiting, dry mouth, biliary tract spasm, constipation, ileus, Intestinal obstruction.

- Cardiovascular

  Flushing of the face, chills, tachycardia, bradycardia, palpitation, faintness, syncope, hypotension, hypertension.

- Genitourinary

  Urine retention or hesitance, reduced libido and/or potency.

- Dermatologic

  Pruritus, urticaria, other skin rashes, oedema, diaphoresis.

PHENOBARBITONE :-

1-ADMINISTRATION ROUTES:-

IV, PO

2-ALTERNATIVE NAMES:-

Phenobarbitone

3-CLINICAL PHARMACOLOGY:-

The barbiturates are nonselective central nervous system (CNS) depressants which are primarily used as sedative hypnotics and are also anticonvulsants in subhypnotic doses.

4- ICU INDICATIONS:-

Treatment of status epilepticus in children (in accordance with the Starship protocol)

5-PRESENTATION AND ADMINISTRATION:-

i- IV

- 200mg in 1ml of phenobarbitone
- For direct IV injection, dilute dose to at least ten times its volume with water for injection.
- Inject slowly at a rate not exceeding 60mg/min.
- Dilute immediately before use. Do not store diluted solution. Do not use any Solution that contains a precipitate or is more than slightly discolored.
- May be given into side arm when any of the following fluids are being infused; 0.9% sodium chloride Hartmanns 5% and 10% dextrose Glucose and sodium chloride
- Store at room temperature
- Protect from light
- Controlled Drug – stored in ICU CD cupboard

ii- IM

May be given IM – no more than 5ml of solution at any one site

iii- PO

- Tablets

  Phenobarbitone 15mg and 30mg tablets

- Oral Liquid

  Phenobarbitone oral liquid 10mg/ml

6-DOSAGE:-

i- IV

Loading dose of 20mg/kg.

ii- PO, IM, IV

Usual maintenance 300mg/day

7-DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  - <10 - reduce dose by 25-50%; avoid very large doses
  - 10-20 - dose as in normal renal function but avoid very large doses
  - >20-50 - dose as in normal renal function
- Dose in renal replacement therapy
  - CAPD - reduce dose by 25-50%; avoid very large doses
  - HD - reduce dose by 25-50%; avoid very large doses

8- DOSAGE IN PAEDIATRICS:-

IV

20mg/kg over 20 minutes. If necessary may be given as IV push over 5-10 mins

9- CONTRAINDICATIONS:-

i- Known barbiturate sensitivity
ii- Porphyria
iii- Marked impairment of liver function

10- WARNINGS :-

IV Administration

Rapid administration may cause respiratory depression, apnea, laryngospasm, Or vasodilation with fall in blood pressure.

11-PRECAUTIONS :-

- General

Parenteral solutions of barbiturates are highly alkaline. Therefore, extreme care should be taken to avoid perivascular extravasation or intra-arterial injection. Extravascularinjection may cause local tissue damage with subsequent necrosis; consequences ofintra-arterial injection may vary from transient pain to gangrene of the limb. Anycomplaint of pain in the limb warrants stopping the injection.

12-Laboratory Tests:-

No tests in addition to routine ICU tests are indicated

13-Drug/Laboratory Test Interactions:-

None noted

14-IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Warfarin

Phenobarbital lowers the plasma levels of warfarin and causes a decrease in anticoagulant activity as measured by the prothrombin time.

- Corticosteroids

Barbiturates appear to enhance the metabolism of exogenous corticosteroids, Probably through the induction of hepatic microsomal enzymes. Patients stabilized on corticosteroid therapy may require dosage adjustments if barbiturates are added to or withdrawn from their dosage regimen.

- Phenytoin, Sodium Valproate

The effect of barbiturates on the metabolism of phenytoin appears to be variable. Some investigators report an accelerating effect, while others report no effect. Because theeffect of barbiturates on the metabolism of phenytoin is not predictable, phenytoin andbarbiturate blood levels should be monitored more frequently if these drugs are given concurrently. Sodium valproate appear to decrease barbiturate metabolism; therefore, barbiturate blood levels should be monitored and appropriate dosage adjustments made as indicated.

- Central Nervous System Depressants

The concomitant use of other central nervous system depressants, including Other sedatives or hypnotics, antihistamines, tranquilizers, or alcohol, may produce additivedepressant effects.

15- ADVERSE REACTIONS :-

- Body as a Whole

hypersensitivity reactions (angioedema, skin rashes, exfoliative dermatitis), fever

- Nervous System

Agitation, headache, confusion, hyperkinesia, ataxia, CNS depression, nightmares, nervousness, psychiatric disturbance, hallucinations, insomnia, anxiety, dizziness, thinking abnormality.

- Respiratory System

Hypoventilation, apnea.

- Cardiovascular System

Bradycardia, hypotension, syncope.

- Digestive System

Nausea, vomiting, constipation, liver damage.

- Haematological System

Megaloblastic anaemia following chronic phenobarbital use.

PHENYLEPHRINE :-

1- ADMINISTRATION ROUTES:-

IV, PO

2-ALTERNATIVE NAMES:-

Neo-Synephrine

3- CLINICAL PHARMACOLOGY:-

- Phenylephrine hydrochloride is a powerful postsynaptic alpha-receptor Stimulant with little effect on the beta-receptors of the heart.
- The predominant actions ofphenylephrine hydrochloride are on the cardiovascular system.

4- ICU INDICATIONS:-

Hypotension

5- PRESENTATION AND ADMINISTRATION:

IV

- 10mg in 1ml (10%) solution
- Add 10mg to 100ml of compatible IV fluid and administered by infusion
- Compatible with Normal saline and 5% glucose
- Discard any solution not used within 24 hours of preparation
- Store at room temperature.

6-DOSAGE:-

- IV
  - For hypotension, 100-500mcg PRN
  - For infusion, administer by infusion at 0-60ml/hr (at higher doses, consider Commencing noradrenaline)

7-DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:

- Dose as in normal renal function

8-DOSAGE IN PAEDIATRICS:

- IV
  - 2-10 mcg/kg stat (adult 500mcg), then 1-5mcg/kg/min

9- CONTRAINDICATIONS:

i- Hypotension solely due to low cardiac output

ii- Hypersensitivity to phenylephrine

10- WARNINGS

Contains sodium metabisulfite, a sulfite that may cause allergic-type reactions includinganaphylactic symptoms and life-threatening or less severe asthmatic

episodes in certainsusceptible people. The overall prevalence of sulfite sensitivity in the general populationis unknown and probably low. Sulfite sensitivity is seen more frequently in asthmaticthan in nonasthmatic people.

11-PRECAUTIONS

General

Phenylephrine hydrochloride should be employed only with extreme caution in elderlypatients or in patients with hyperthyroidism, bradycardia, partial heart block, myocardialdisease, or severe arteriosclerosis.

12-Laboratory Tests:

No tests in addition to routine ICU tests are indicated

13- Drug/Laboratory Test Interactions:

None noted

14-IMPORTANT DRUG INTERACTIONS FOR THE ICU

None of note

15-ADVERSE REACTIONS

- Cardiovascular

  Arrhythmia (rare), decreased cardiac output, hypertension, pallor, precordial pain ordiscomfort, reflex bradycardia, severe peripheral and visceral vasoconstriction

- Central nervous system

  Anxiety, dizziness, excitability, giddiness, headache, insomnia, nervousness, restlessness

- Endocrine & metabolic

  Metabolic acidosis

- Gastrointestinal

  Gastric irritation, nausea

- Neuromuscular & skeletal

  Paraesthesia, pilomotor response, tremor, weakness

- Renal

  Decreased renal perfusion, reduced urine output

- Respiratory

  Respiratory distress

- Miscellaneous

  Hypersensitivity reactions (including rash, urticaria, leukopaenia, agranulocytosis, thrombocytopaenia)

PHENYTOIN :-

1- ADMINISTRATION ROUTES:

IV, PO

2-ALTERNATIVE NAMES:

Phenytoin, Dilantin

3- CLINICAL PHARMACOLOGY:

Phenytoin sodium is an antiepileptic drug. Phenytoin sodium is related to the barbiturates in chemical structure.

4- ICU INDICATIONS:

Seizures and seizure prophylaxis

5- PRESENTATION AND ADMINISTRATION:

i- IV

- 100mg/2ml and 250mg/5ml
- Direct IV injection

Inject undiluted into a large vein at a rate not exceeding 50mg/min and for children andneonates not exceeding 3mg/kg/min. A slower rate of administration (e.g. notexceeding 25mg/min and if necessary as slow as 5-10mg/min) is recommended inpatients with cardiovascular disease and the elderly in order to reduce cardiovascularside effects. Follow injection into a vein with 20ml of normal saline to reduce theirritation caused by the alkalinity of the solution (if administering via a peripheral vein)

- Intermittent infusion

Dilute phenytoin in 50-100ml of normal saline immediately before use (final concentration not to exceed 6.7mg/ml). Infuse within 1 hour. Infuse via an in-line filter(0.22-0.5 micron) at a rate not exceeding 50mg/min (children and neonates, give at arate of 1-3mg/kg/min). Inspect closely for appearance of precipitate during infusion.Note that intermittent infusion, although widely used, is not recommended by themanufacturer due to the risk of precipitation.

- Compatible with normal saline ONLY.

ii- PO

Dilantin infatabs 50mg tablets
Dilantin 30mg capsules , 100mg capsules
Dilantin paediatric suspension 30mg/5ml

6-DOSAGE:

i- IV

- Loading dose in an emergency: 15-20mg/kg (max 1.5gm) IV over 1 hour.
- Maintenance,

100mg three times daily IV or PO. 300mg once daily can also be used for Maintenancetherapy.

ii- PO / NG

For NG use, stop feed for 2 hours before and 2 hours after administration of Oralphenytoin dose. 300mg once daily can also be used for maintenance

therapy.

Note: - Oral Capsules, IV medication & liquid are NOT bioequivalent dose adjustment isNeeded

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:

Dose as in normal renal function

8-DOSAGE IN PAEDIATRICS:

- Loading dose in an emergency: 15-20mg/kg (max 1.5gm) IV over 1 hour.
- Initial maintenance, oral of IV: 2mg/kg 12 hourly (preterm); 3mg/kg 12 hourly (1st week of life),8 hourly (2wk-4yr), 12 hourly (5-12 yr); 2mg/kg (usual max 100mg) 8 hourly (12 yrs)

9- CONTRAINDICATIONS:

Hypersensitivity to phenytoin

10- WARNINGS

- Withdrawal

  Abrupt withdrawal of phenytoin in epileptic patients may precipitate status epilepticus.When, in the judgment of the clinician, the need for dosage reduction, discontinuation,or substitution of alternative antiepileptic medication arises, this should be done gradually. However, in the event of an allergic or hypersensitivity reaction, rapid substitution of alternative therapy may be necessary.

- Effect of alcohol

  Acute alcoholic intake may increase phenytoin serum levels, while chronic alcohol usemay decrease serum levels.

- Use in pregnancy

  A number of reports suggest an association between the use of antiepileptic drugs,including phenytoin, by women with epilepsy and a higher incidence of birth defects inchildren born to these women.

11- PRECAUTIONS

- General
  - Phenytoin is NOT indicated for toxicological seizures or seizures due to hypoglycaemia.Phenytoin should be discontinued if a skin rash appears. If the rash is exfoliative,purpuric, or bullous or if lupus erythematosus, Stevens-Johnson syndrome, or toxicepidermal necrolysis is suspected, use of this drug should not be resumed andalternative therapy should be considered.
  - The liver is the chief site of biotransformation of phenytoin; patients with impaired liverfunction, elderly patients, or those who are gravely ill may show early signs of toxicity.A small percentage of individuals who have been treated with phenytoin have beenshown to metabolize the drug slowly. Slow metabolism may be due to limited enzymeavailability and lack of induction; it appears to be genetically determined.
  - Phenytoin is not effective for absence (petit mal) seizures. If tonic-clonic (grand mal)and absence (petit mal) seizures are present, combined drug

therapy is needed.

12- Laboratory Tests:

- Phenytoin levels should only be measured if there is a specific clinical indication (i.e. ifthere is concern about toxicity or ongoing seizures despite phenytoin administration)Specimens should be collected in SST (Yellow) or Plain (Red). Sampling time is notcritical. Routine specimens are for total phenytoin. It is possible to measure freephenytoin (green tube); however, this is a send away test and is not routinely indicated.
  For patients with low albumin total phenytoin levels will not represent active Phenytoinlevels in the blood.

13- Drug/Laboratory Test Interactions:

None known.

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

- Drugs which may increase phenytoin serum levels include: acute alcohol intake,amiodarone, diazepam, warfarin, H2-antagonists, isoniazid, and sulfonamides.
- Drugs which may decrease phenytoin levels include: carbamazepine, chronic Alcohol abuse,
- Drugs which may either increase or decrease phenytoin serum levels include: phenobarbital, sodium valproate, and valproic acid.
- Although not a true drug interaction, tricyclic antidepressants may precipitate seizures insusceptible patients and phenytoin dosage may need to be adjusted.
- Drugs whose efficacy is impaired by phenytoin include: corticosteroids, warfarin, frusemide, oral contraceptives, rifampin, and theophylline.

15- ADVERSE REACTIONS

- Central Nervous System
  Nystagmus, ataxia, slurred speech, decreased coordination and mental confusion.
- Gastrointestinal System
  Nausea, vomiting, constipation, toxic hepatitis and liver damage.
- Skin
  Dermatological manifestations sometimes accompanied by fever have included scarlatiniform or morbilliform rashes. A morbilliform rash (measles-like) is the mostcommon; other types of dermatitis are seen more rarely. Other more serious formswhich may be fatal have included bullous, exfoliative or purpuric dermatitis, lupuserythematosus, Stevens-Johnson syndrome, and toxic epidermal necrolysis.
- Haemopoietic System
  Thrombocytopaenia, leukopaenia, granulocytopaenia, agranulocytosis, and pancytopaenia with or without bone marrow suppression. While macrocytosis andmegaloblastic anaemia have occurred, these conditions usually respond to folic acidtherapy. Lymphadenopathy including benign lymph node hyperplasia,pseudolymphoma, lymphoma, and Hodgkin's disease have been reported.
- Cardiovascular

Bradycardia, heart block, periarteritis nodosa.

- Immunologic

Hypersensitivity syndrome (which may include, but is not limited to, symptoms such asarthralgias, eosinophilia, fever, liver dysfunction, lymphadenopathy or rash), systemiclupus erythematosus, and immunoglobulin abnormalities.

POTASSIUM CHLORIDE :-

1- ADMINISTRATION ROUTES:-

IV, PO, NG

2- ALTERNATIVE NAMES:

Potassium Chloride, slow K, Chlorvescent Effervescent tablets

3- CLINICAL PHARMACOLOGY:

The potassium ion is the principal intracellular cation of most body tissues. Potassiumions participate in a number of essential physiological processes including themaintenance of intracellular tonicity, the transmission of nerve impulses, the contractionof cardiac, skeletal and smooth muscle and the maintenance of normal renal function.

4- ICU INDICATIONS:

Hypokalaemia

5- PRESENTATION AND ADMINISTRATION:

i- IV

- 20 , 40 , mlEq in 10 mL
- Maximum peripheral vien infusion rate is10 mlEq /100mL saline over one hour
- Maximum central vien infusion rate is 20 mlEq /100mL saline over one hour
- When KCl has been added o IV fluids or when commercial preparations are opened,discard any solution not used within 24 hours. Do not use cloudy solutions.
- Compatible with 0.9% sodium chloride ,5%, 10% & 20% glucose .
- Store at room temperature

ii- PO

Chlorvescent Effervescent tablets (each contains 14mmol of potassium)

Span K sustained release tablets (each contains 8mmol of potassium)

6- DOSAGE:

i- IV

Serum k	Replacement dose

3.6 --------- 3.9 mmol/L	**20 mEq over 2 hours**
3.4 --------- 3.5 mmol/L	**30 mEq over 3hours**
3.1 --------- 3.3 mmol/L	**40 mEq over 4 hours**
2.6 --------- 3 mmol/L	**50 mEq over 50 hours**
2.3 -------- 2.5 mmol/L	**60 mEq over 6 hours**

- if the patient is NPO add daily requirementWhich is (1mEq/L /kg /day)

ii- PO

Dose according to requirements and response.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:

- Dose in renal impairment [GFR (ml/min)]
  - <10 - dose according to response
  - 10-20 - dose according to response
  - 20-50 - dose according to response
- Dose in renal replacement therapy
  - CAPD - dose according to response
  - HD - dose according to response

8 - DOSAGE IN PAEDIATRICS:

- IV
  - Deficiency: usually 0.3mmol/kg/hr (max 0.4mmol/kg/hr) for 4-6 hours IV, then 4mmol/kg/day Max oral dose 1mmol/kg (<5years); 0.5mmol/kg (>5years).
  - If given peripherally via IV route, max 0.05mmol/ml

9- CONTRAINDICATIONS:

Hyperkalaemia

10- WARNINGS

In patients with impaired mechanisms for excreting potassium, the administration ofpotassium salts can produce hyperkalaemia and cardiac arrest.

11- PRECAUTIONS

General

Solid oral dosage forms of potassium chloride can produce ulcerative and/or Stenoticlesions of the gastrointestinal tract.

12- Laboratory Tests:

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

Simultaneous administration of ACE inhibitors or potassium sparing diuretics (egspironolactone) with KCl may lead to hyperkalaemia.

15- ADVERSE REACTIONS

- Body as a Whole:
  Hyperkalaemia
- Gastrointestinal system (with oral preparations):
  GI upset, ulcer, perforation, bleeding
- Local
  Injection site pain

PHOSPHATE :-

1- ADMINISTRATION ROUTES:-

IV, PO

2- ALTERNATIVE NAMES:-

Potassium dihydrogen phosphate, Phosphate Sandoz

3- CLINICAL PHARMACOLOGY:-

Phosphorus in the form of organic and inorganic phosphate has a variety of Importantbiochemical functions in the body and is involved in many significant metabolic andenzyme reactions in almost all organs and tissues. It exerts a modifying influence on thesteady state of calcium levels, a buffering effect on acid-base equilibrium and a primaryrole in the renal excretion of hydrogen ion.

4- ICU INDICATIONS:

Hypophosphataemia

5- PRESENTATION AND ADMINISTRATION:-

i- IV

- 10ml vial (1mmol/ml potassium, 1mmol/ml phosphate)
  Add required dose to 100ml of compatible IV fluid. Administer at no greater Than20mmol per hour.
- Use a central line if possible; if administration is necessary via a peripheral line it ispreferable to add the required dose to 500ml or 1000ml
- Discard any solution not used within 24 hours of preparation
- Do not use solution that is cloudy or shows precipitate
- Compatible with 0.9% sodium chloride and 5% glucose
- Store at room temperature.

ii- PO

Phosphate Sandoz Effervescent tablets

6- DOSAGE:-

i- IV

Individualise dosage. Usually in ICU administer 1vial over 1 hour and repeat Asrequired

ii- PO

Dose according to requirements and response. Note oral phosphate replacement isoften not particularly effective in the ICU setting and is generally not indicated

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  <10 - dose according to response
  10-20 - dose according to response
  20-50 - dose according to response
- Dose in renal replacement therapy
  CAPD - dose according to response
  HD - dose according to response

Note:- usually phosphate replacement is not appropriate in the setting of renal Failure unless the patient is on renal replacement therapy

8- DOSAGE IN PAEDIATRICS:-

IV

0.15-0.33mmol/kg administered over 6 hours; may be repeated at 6 hour

intervals untilserum phosphate exceeds 0.6mmol/L. Dose should not exceed the maximumrecommended adult dose. Rate of infusion should not exceed 0.2mmol/kg/hr.

9- CONTRAINDICATIONS:-

i- Hyperphosphataemia
ii- Hyperkalaemia

10- WARNINGS :-

To avoid potassium or phosphorus intoxication, infuse solutions containing Potassiumphosphates slowly. In patients with severe renal or adrenal insufficiency, administrationof potassium phosphates injection may cause potassium intoxication. Infusing highconcentrations of phosphorus may cause hypocalcaemia, and calcium levels should bemonitored.

11- PRECAUTIONS :-

- General

Phosphorus replacement therapy with potassium phosphates should be guided primarily by the serum inorganic phosphorus levels and the limits imposed by theaccompanying potassium (K+) ion.

12- Laboratory Tests:

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

None of note.

15- ADVERSE REACTIONS

- Hyperphosphataemia
- Hyperkalaemia
- Hypomagnesaemia
- Hypocalcaemia

PREDNISONE :-

1- ADMINISTRATION ROUTES:-

PO, NG

2- ALTERNATIVE NAMES:-

Apo-Prednisone

3- CLINICAL PHARMACOLOGY:

Prednisone is a steroid hormone which has glucocorticoid and Mineralocorticoidproperties. 1mg prednisone = hydrocortisone 4mg in glucocorticoid activity, 0.8mg inmineralocorticoid

4- ICU INDICATIONS:-

i- Relative corticosteroid insufficiency in patients with severe septic shock
ii- Adrenal insufficiency
iii- Steroid responsive inflammatory conditions

5- PRESENTATION AND ADMINISTRATION:-

- PO / NG
  - Prednisone sodium phosphate liquid 5mg/ml
  - Apo-prednisone 20mg , 20mg , 5mg, 1mg

6- DOSAGE:-

- PO

Initially 10mg-100mg daily as a single morning dose or divided doses depending onindication.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

- PO

Asthma: 0.5-1mg/kg for 24 hours, then every 12 hours for two doses, then 1mg/kg daily.

- Croup: 1mg/kg stat and in 12 hours; severe 4mg/kg then 1mg/kg 8 hourly

9- CONTRAINDICATIONS:-

Systemic fungal infections

10- WARNINGS

i - Steroid induced myopathy
  - An acute myopathy has been observed with the use of high doses of corticosteroids,most often occurring in patients with disorders of neuromuscular transmission (e.g.,myasthenia gravis), or in patients receiving concomitant therapy with neuromuscular blocking drugs. This acute myopathy is generalized, may involve ocular and respiratory muscles, and may result in quadriparesis. Elevations of creatine kinase may occur.
  - Clinical improvement or recovery after stopping corticosteroids may require weeks To years.

ii- Adrenal-insufficiency due to steroids

In patients on corticosteroid therapy subjected to unusual stress, increased dosage ofrapidly acting corticosteroids before, during, and after the stressful situation is indicated.

iii- Infections

Corticosteroids may mask some signs of infection, and new infections may Appearduring their use.

iv- Blood pressure

Average and large doses of hydrocortisone can cause elevation of blood pressure, salt and water retention, and increased excretion of potassium. These effects are less likely to occur with the synthetic derivatives except when used in large doses.

11- PRECAUTIONS :-

- General

There is an enhanced effect of corticosteroids in patients with hypothyroidism and inthose with cirrhosis.

Psychic derangements may appear when corticosteroids are used, ranging From euphoria, insomnia, mood swings, personality changes, and severe depression to frank psychotic manifestations. Also, existing emotional instability or psychotic tendenciesmay be aggravated by corticosteroids.

12- Laboratory Tests :-

No tests in addition to routine ICU tests are required

13- Drug/Laboratory Test Interactions

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

The pharmacokinetic interactions listed below are potentially clinically important. Drugsthat induce hepatic enzymes such as phenobarbital, phenytoin and rifampin mayincrease the clearance of corticosteroids and may require increases in corticosteroid dose to achieve the desired response.

15- ADVERSE REACTIONS

- Fluid and Electrolyte Disturbances

Sodium retention; fluid retention; congestive heart failure in susceptible patients;potassium loss; hypokalemic alkalosis; hypertension.

- Musculoskeletal

Muscle weakness; steroid myopathy, loss of muscle mass; osteoporosis; Tendonrupture, particularly of the Achilles tendon; vertebral compression fractures; asepticnecrosis of femoral and humeral heads; pathologic fracture of long bones.

- Gastrointestinal

Peptic ulcer with possible perforation and haemorrhage; pancreatitis; Abdominaldistention; ulcerative oesophagitis; increases in alanine transaminase (ALT, SGPT),aspartate transaminase (AST, SGOT) and alkaline phosphatase have been observedfollowing corticosteroid treatment.

- Dermatologic

Impaired wound healing; thin fragile skin; petechiae and ecchymoses; facial erythema;increased sweating; may suppress reactions to skin tests.

- Neurological

Convulsions; increased intracranial pressure with papilloedema (pseudotumour

cerebri)usually after treatment; vertigo; headache.

- Endocrine:

Menstrual irregularities; development of Cushingoid state; suppression of growth inchildren; secondary adrenocortical and pituitary unresponsiveness, particularly in timesof stress, as in trauma, surgery or illness; decreased carbohydrate tolerance;manifestations of latent diabetes mellitus; increased requirements for insulin or oralhypoglycaemic agents in diabetics.

Propofol :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Diprivan

3- CLINICAL PHARMACOLOGY:

Propofol injectable emulsion is an intravenous sedative-hypnotic agent for use in theinduction and maintenance of anaesthesia or sedation.

4- ICU INDICATIONS:

i- Sedation

ii- Induction of Anaesthesia

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 1% propofol (diprivan) 200mg in 20ml and 500mg in 50ml.
  - Administer undiluted by bolus or IV infusion
  - Compatibility of propofol injectable emulsion with the coadministration of blood/serum/,plasma has not been established. When administered using a y-type infusion set,propofol injectable emulsion has been shown to be
  - compatible with 5% Dextrose injection and 5% .
  - Store at room temperature

6- DOSAGE:-

- IV
  - Induction of anaesthesia: doses vary widely in the critically ill (typically 20mg to 200mg)
  - Sedation: usual doses of 0-20ml/hr; doses of >20ml/hr should not be used for greaterthan 24 hours due to the risk of propofol infusion syndrome .

7-DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:_

- IV
  - Sedation in ICU: 1-3mg/kg/hr (max 4mg/kg/hr) IV for no longer than 48 hours.
  - Short term anaesthesia: child 2.5-3.5mg/kg stat, then 7.5-15mg/kg/hr IV.

9- CONTRAINDICATIONS:-

known hypersensitivity to propofol

10- WARNINGS :-

- Strict aseptic technique must be always maintained during handling .
- Propofol infusion syndrome is a rare syndrome which can lead to cardiac failure,rhabdomyolysis, metabolic acidosis and renal failure and is often fatal.It usually effectspatients undergoing long-term treatment with high doses of propofol.

11- PRECAUTIONS :-

General

A lower dose of propofol should be used in patients with haemodynamic instability at thetime of induction; consider the use of an alternative agent

Clinical features of anaphylaxis, which may include angioedema, bronchospasm,erythema, and hypotension, may occur following propofol injectable emulsionadministration

Reports of bradycardia, asystole, and rarely, cardiac arrest have been associated withpropofol injectable emulsion.

12 - Laboratory Tests

No tests in addition to routine ICU tests are required

13- Drug/Laboratory Test Interactions

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

Propofol requirements are reduced by concomitant administration of opioids and/orbenzodiazepines

15- ADVERSE REACTIONS

- Body as a Whole
  Propofol infusion syndrome
- Cardiovascular
  Bradycardia; arrhythmia; tachycardia; hypotension; decreased cardiac output
- Central Nervous System
  Myoclonic jerking (NOT seizure activity)
- Metabolic/Nutritional
  Hyperlipemia
- Injection Site
  Burning/stinging or pain.
- Respiratory
  Apnea
- Skin and Appendages
  Rash, pruritus.

PROPRANOLOL :-

1- ADMINISTRATION ROUTES:-

PO

2-ICU INDICATIONS:-

i- Thyrotoxic crisis

ii- Use as a centrally acting beta blocker

3- CLINICAL PHARMACOLOGY:-

Propranolol hydrochloride is a synthetic non-selective beta-adrenergic receptor Blockingagent. It is the first line agent for thyrotoxicosis because it reduces Peripheralconversion of T4 to T3.

4- PRESENTATION AND ADMINISTRATION:-

- PO
  - Tablets
    INDERAL 10mg tablets , and 40mg .

5- DOSAGE:-

- PO
  Usual dosage for thyrotoxicosis, 10mg- 40mg 3-4 times a day; usual maximum Dosage320mg daily in divided doses

6- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  <10 - start with small doses
  10-20 - start with small doses
  >20-50 - dose as in normal renal function
- Dose in renal replacement therapy
  CAPD - start with small doses
  HD - start with small doses

7- DOSAGE IN PAEDIATRICS:-

- PO
  - 0.2-0.5mg/kg 6-12 hourly oral; slowly increase to 1.5mg/kg 6-12 hr if required

8- CONTRAINDICATIONS:-

i- sinus bradycardia,
ii- heart block greater than first degree,
iii- cardiogenic shock,
iv- overt cardiac failure
v- asthma

9-WARNINGS :-

- Cardiac Failure
  Sympathetic stimulation is necessary in supporting circulatory function in Congestiveheart failure, and beta blockade carries the potential hazard of further depressingmyocardial contractility and precipitating more severe failure.
- Discontinuation of therapy
  Discontinuation of therapy in a patient with coronary artery disease may lead to reboundangina, arrhythmia or myocardial infarction.
- Diabetes and Hypoglycaemia
  Beta blockers may mask tachycardia occurring with hypoglycaemia.
- Thyrotoxicosis
  Beta-adrenergic blockade may mask certain clinical signs (e.g., tachycardia) of

hyperthyroidism. Abrupt withdrawal of beta blockade might precipitate a thyroid storm.

10- PRECAUTIONS :-

General

Beta blockers may aggravate peripheral arterial circulatory disorders.

11- Laboratory Tests:

No tests in addition to routine ICU tests are required

12- Drug/Laboratory Test Interactions:

None known

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU

Beta blockers may exacerbate the rebound hypertension which can follow the withdrawal of clonidine

14- ADVERSE REACTIONS

- Body as a Whole
  Tiredness, Fatigue
- Cardiovascular System
  Bradycardia , Cold extremities, Hypotension, Leg pain
- Respiratory System
  Wheeziness, Dyspnoea
- Digestive System
  Diarrhoea, Nausea
- Nervous System
  Dizziness, Vertigo, Light-headedness

PROTAMINE SULPHATE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Protamine

3- CLINICAL PHARMACOLOGY:-

Protamine is used to counteract the anticoagulant effect of heparin through The formation of heparin-protamine complexes. The onset of action of protamine occurs within five minutes following intravenous administration.

The fate of the protamine heparincomplex is unknown, but it may be partially degraded, thus freeing heparin.

4- ICU INDICATIONS:-

Reversal of heparin

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 50mg in 5ml (solution).
  - Administer by slow IV injection over no greater than 1ml/minute (i.e. 50mg over 5minutes). Watch the blood pressure trace closely during administration

    and slow rate ofinfusion if the blood pressure drops.
  - Administration by IV infusion is described but is not generally preferred. To administerby IV infusion, add to a suitable volume of compatible IV fluid and administer overrequired time period
  - Compatible with 0.9% Sodium chloride and5% Dextrose
  - Store at room temperature. Protect from light.

6- DOSAGE:-

- IV

i- For neutralisation of unfractionated heparin:-

1mg of protamine sulphate will usually neutralise at least 100 international units ofmucous heparin or 80 units of lung heparin. The dose of protamine sulphate should bereduced if more than 15 minutes have elapsed since intravenous injection.

- For example, if 30-60 minutes have elapsed since heparin was injected intravenously, 0.5-0.75mg protamine sulphate per 100 units of mucous heparin is recommended.
- Iftwo hours or more have elapsed, 0.25-0.375mg per 100 units of mucous heparin should be administered.

- If the patient is receiving an intravenous infusion of heparin, the infusion should Be stopped and 25-50mg of protamine sulphate given by slow intravenous injection.
- In the reversal of UF heparin following cardiopulmonary bypass, either a standard Dose of protamine may be given, as above, or the dose may be titrated according to the activated clotting time or TEG.

ii-Neutralisation of low molecular weight (LMW) heparin :-

- A dose of 1mg per 100 units is usually recommended. The anti-Xa activity of LMW heparins may not be completely reversible with protamine sulphate and may persist forup to 24 hours after administration.

  The longer half-life of LMW heparins (approximately twice that of UF heparin) Should also be borne in mind when estimating the dose of protamine sulphate required inrelation to the time which has elapsed since the last heparin dose.
- Theoretically, the dose of protamine sulphate should be halved when one half-life haselapsed since the last LMW heparin dose.
- Intermittent injections or continuous infusion of protamine sulphate have been

recommended for the neutralisation of LMW heparin following subcutaneous administration, as there may be continuing absorption from the subcutaneous depot.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

- IV

1mg/100 IU of heparin (0.5mg/100 IU of heparin if > 1 hour since heparin dose); subsequent doses of protamine 1mg/kg (max 50mg)

9- CONTRAINDICATIONS:-

Hypersensitivity to protamine

10- WARNINGS :-

- Hypotension

Rapid administration of protamine may lead to severe hypotension and Anaphylactoid Reactions

11- PRECAUTIONS:-

- General

In patients who have had cardiac surgery with cardiopulmonary bypass, a Rebound bleeding effect may occur hours post-operatively.
This responds to further doses ofprotamine.

12- Laboratory Tests:-

No tests in addition to routine ICU tests are required

13- Drug/Laboratory Test Interactions:-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

None known

15- ADVERSE REACTIONS

- Body as a Whole

Anaphylaxis, angioedema

- Cardiovascular System

Hypotension, flushing

- Respiratory System

Non cardiogenic pulmonary oedema

- Digestive System

Nausea, vomiting

REMIFENTANIL :-

1- ADMINISTRATION ROUTES:

IV

2- ALTERNATIVE NAMES:

Ultiva

3- CLINICAL PHARMACOLOGY:

Remifentanil opioid agonist

4- ICU INDICATIONS:

Opioid analgesia

5- PRESENTATION AND ADMINISTRATION:

- IV
  - Administer by intravenous infusion. Dilute 2mg in 40ml of compatible IV fluid to make a concentration of 50mcg/ml
  - Compatible with Water for Injection, 5% Dextrose and 0.9% Sodium Chloride

6- DOSAGE:

-IV

- Initially, 0.1-0.15mcg/kg/min; may titrate by 0.025mcg/kg/min at intervals of at least 5 minutes to desired level of analgesia or sedation; consider initiation of another sedativeif desired level of sedation is not achieved with 0.2mcg/kg/min

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:

- IV

0.05-0.2mcg/kg/min. Ventilated: usually 0.5-1mcg/kg/min; occasionally up to 8mcg/min

9- CONTRAINDICATIONS:

Hypersensitivity to remifentanil

10- WARNINGS

- Muscle Rigidity

At the doses recommended muscle rigidity may occur. As with other opioids, The incidence of muscle rigidity is related to the dose and rate of administration

11- PRECAUTIONS

- General
  - As with all potent opioids, profound analgesia is accompanied by marked Respiratory depression.Due to the very rapid offset of action of remifentanil, no residual opioid Activitywill bepresent within 5-10 minutes after the discontinuation of remifentanil Symptoms including tachycardia, hypertension and agitation have been reported uponAbrupt cessation, particularly after prolonged administration of remifentanil.

12- Laboratory Tests:

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions :

None known.

15- IMPORTANT DRUG INTERACTIONS FOR THE ICU

The concomitant administration with other cardiovascular depressant drugs

leads to an increased risk of hypotension; concomitant administration with other CNS depressantdrugs also increases the risk of CNS depression.

16- ADVERSE REACTIONS:

- Body as a Whole
  Anaphylaxis
- Central nervous system.
  Skeletal muscle rigidity, Sedation.
- Cardiovascular system.
  Asystole, bradycardia, hypotension.
- Gastrointestinal system
  Constipation, nausea/ vomiting.
- Respiratory system
  Apnoea
- Dermatological system
  Pruritis

ROCURONIUM :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Esmeron

3- CLINICAL PHARMACOLOGY:-

Rocuronium is a fast onset, intermediate acting non-depolarizing neuromuscular blocking agent.

4- ICU INDICATIONS:-

Muscle relaxant

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 50mg in 5ml solution
  - Supplied as a clear, aqueous solution for intravenous injection.
  - Administer neat for IV injection or infusion
  - Compatible with 5% dextrose and normal saline .
  - Store in the refrigerator at 2-8°C. The product can be stored outside the refrigerator at atemperature of up to 30°C for a maximum of 12 weeks.
  - The product may not be placedback, once kept outside the refrigerator.

6- DOSAGE:-

- IV

  0.6-1.2mg/kg stat, then 0.1-0.2mg/kg boluses or 5-15mcg/kg/min

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function (duration of action may be prolonged)

8- DOSAGE IN PAEDIATRICS:-

- IV

  0.6-1.2mg/kg stat, then 0.1-0.2mg/kg boluses or 5-15mcg/kg/min

9- CONTRAINDICATIONS:-

Hypersensitivity to rocuronium

10- WARNINGS :-

Anaphylactic reactions can occur following the administration of neuromuscular Blocking agents including rocuronium.

11- PRECAUTIONS

- General
  - In general, following long term use of neuromuscular blocking agents in the ICU,prolonged paralysis and/or skeletal muscle weakness has been noted. Myopathy afterlong term administration of other non-depolarizing neuromuscular blocking agents in theICU in combination with corticosteroid therapy has been reported regularly. Therefore,for patients receiving both neuromuscular blocking agents and corticosteroids, theperiod of use of the neuromuscular blocking agent should be limited as much aspossible.
  - Like other neuromuscular blocking agents, rocuronium should be used with Extreme caution in patients with a neuromuscular disease

12- Laboratory Tests:-

No tests additional to routine ICU tests are required

13- Drug/Laboratory Test Interactions :-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Drugs which may enhance the neuromuscular blocking action of rocuronium include:
certain antibiotics, especially the aminoglycosides and polymyxins;
lithium; magnesiumsalts; procainamide; and quinidine.
- The prior administration of succinylcholine does not enhance the duration, but quickensthe onset and may increase the depth, of neuromuscular block induced by rocuronium

15- ADVERSE REACTIONS

- General
  Allergic reactions (anaphylactic or anaphylactoid responses) which, in rare instances,were severe (e.g., cardiac arrest).
- Musculoskeletal
  Inadequate block, prolonged block.
- Cardiovascular
  Hypotension, vasodilatation (flushing), tachycardia, bradycardia.
- Respiratory
  Dyspnea, bronchospasm, laryngospasm.
- Integumentary
  Rash, urticaria, reaction at injection site.

SALBUTAMOL :-

1- ADMINISTRATION ROUTES:-

IV, Nebulised, Inhaler

2- BRAND NAMES:-

Ventolin, Combivent, Duolin, Albuterol, Respigen, Salamol.

3- CLINICAL PHARMACOLOGY:-

Salbutamol is a selective β2 adrenoceptor agonist which acts on bronchial Smoothmuscle to relieve bronchospasm

4- ICU INDICATIONS:-

1. Bronchospasm
2. Hyperkalaemia (pending definitive treatment)

5- PRESENTATION AND ADMINISTRATION:-

i- IV

- 5mg in 5ml solution.
- For infusion add 5mg to 50ml or 10mg to 100ml of compatible IV fluid.

Note : - that Ventolin solution for IV infusion (5mg in 5ml) should not be injected undiluted.

- If a bolus dose of salbutamol is required, dilute with Water for injection prior toadministration. For example, add 0.5ml (500mcg) to 10ml to make a solution of 50mcg/ml and inject bolus doses of up to 5ml (repeat as required)
- Compatible with 0.9% sodium chloride and 5% glucose
- Store at room temperature.
- Protect from light

ii- Inhaler

- Salamol & ventolin: 100mcg/dose
- Combivent: salbutamol 100mcg/dose plus ipratropium 20mcg/dose

iii- Nebuliser

- Ventolin 2.5mg/2.5ml nebules and 5mg/2.5ml nebules
- Duolin 2.5mg salbutamol and 500mcg ipratropium / 2.5ml nebules

6- DOSAGE:-

i- IV

- Usual bolus dose 250mcg
- Usual infusion range 0-10ml/hr when made up in standard ICU infusion dilution

ii- Inhaler

- For intubated patients, use metered dose inhalers in preference to nebulisers.
- Administer 5-10 puffs into ventilator circuit using MDI adaptor.

iii- Nebuliser

2.5-5mg nebulisers as required (initially continuously if required)

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:

i- IV salbutamol bolus

- Give 10 micrograms/kg (single dose maximum 500 micrograms). Over 2 minutes. Give in a minimum volume of 5ml (can be diluted with 0.9% Saline). Repeatdose at 10 minutes if still not improving

ii- IV salbutamol infusion

- 5 -10 microgram/kg/min for 1 hour then reduce to 1 - 2 microgram/kg/min

a- If Patient Weight < 16kgAdd 3 mg/kg of IV salbutamol solution (1 mg/ml) to a 50 ml syringe and make up to 50ml with 5% dextrose

- Then 1 ml/hr = 1 microgram/kg/min

b- If Patient Weight > 16kg

Draw up neat IV salbutamol solution (1 mg/ml) into a 50ml syringe (i.e. not diluted)

- Then rate (ml/hr) = 0.06 x weight (kg) x dose (microgram/kg/min)

For example :- if you have a 20 kg child and want to infuse salbutamol at 5 microgram/kg/min then set rate at 0.06 x 20 x 5 = 6 ml/hr

9- CONTRAINDICATIONS :-

Hypersensitivity to salbutamol

10- WARNINGS

- Hypokalaemia

Potentially serious hypokaliemia may result from β2 agonist therapy mainly Fromparenteral and nebulised administration. Particular caution is advised in acute severeasthma as this effect may be potentiated by concomitant treatment with xanthinederivatives, steroids, diuretics and hypoxia. It is recommended the serum potassiumlevels are monitored in such situations.

11- PRECAUTIONS :-

- General

Salbutamol should be administered cautiously to patients suffering from hyperthyroidism, cardiovascular disease and diabetes.

12- Laboratory Tests:

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions

None noted.

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

Salbutamol will enhance the activity of other β2 sympathomimetics. β receptor blockingagents such as propranolol inhibit the activity of salbutamol. The effects of salbutamolmay be enhanced by concomitant administration of aminophylline or other xanthines.

15- ADVERSE REACTIONS

- Musculoskeletal system:

fine tremor of skeletal muscle (particularly of the hands), palpitations and muscle cramps.

- Cardiovascular system

Tachycardia, peripheral vasodilation with hypotension

- Hypersensitivity reactions

Angioedema, urticaria, bronchospasm, hypotension and collapse have been reportedrarely.

- Respiratory system

Paradoxical bronchospasm may also occur requiring immediate discontinuation

Of therapy and institution of appropriate treatment.

SILDENAFIL :-

1- ADMINISTRATION ROUTES:-

PO, NG

2- ALTERNATIVE NAMES:

Viagra

3- CLINICAL PHARMACOLOGY:-

Sildenafil is a potent, selective inhibitor of cGMP-specific phosphodiesterase-5

(PDE-5).It has an established therapeutic role as a selective pulmonary vasodilator in patientswith pulmonary hypertension in the non-operative setting. Recent limited data suggestsit may have a similar role in the peri-operative setting in cardiothoracic surgical patients;however, evidence is very limited.

4- ICU INDICATIONS:-

Patients undergoing cardiac surgery who are at risk of, or who suffer from, Perioperativeright ventricular (RV) failure due to raised pulmonary vascular resistance or exacerbation of pre-existing pulmonary hypertension

5- PRESENTATION AND ADMINISTRATION:-

Viagra 25mg ,50mg and 100mg Tablets

6- DOSAGE:

- PO

The typical dose is 50mg 3-4 times daily. In small or very sick patients an initial dose of25mg would be appropriate. For most patients a duration of 3-5 days only isAppropriate

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:

- Dose in renal impairment [GFR (ml/min)]
  - <10 - initially 25mg doses
  - 10-30 - initially 25mg doses
  - >30-50 - dose as in normal renal function
- Dose in renal replacement therapy
  - CAPD - initially 25mg doses
  - HD - initially 25mg doses

8- DOSAGE IN PAEDIATRICS:-

Not applicable

9- CONTRAINDICATIONS:-

See WARNINGS

10- WARNINGS :-

Patients with increased susceptibility to vasodilators (e.g. severe aortic stenosis, leftventricular outflow tract obstructon, hypovolaemia) may be at increased risk ofhypotension with sildenafil.There are no reports in the literature of use in such patients.

11- PRECAUTIONS :-

May cause significant hypotension

12- Laboratory Tests:-

No tests are indicated in addition to routine ICU

13- Drug/Laboratory Test Interactions :-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

- Sildenafil potentiates the hypotensive effects of nitrates. The data sheet states that thecombination of nitrates (nitric oxide donors including GTN, isosorbide salts, sodiumnitroprusside; organic nitrates or organic nitrites) and sildenafil is contraindicated.However, in a recent double-blind placebo-controlled randomised trial of males withcoronary artery disease the combination of sildenafil or placebo and iv GTN up to adose of 80 mcg/min was tolerated without significant hypotension by 70% in thesildenafil group.
- In the peri-operative environment with intensive monitoring instituted it is appropriate to use nitrates if indicated. Nitric oxide co-administration is safe andpotentiates the pulmonary vasodilator effects of sildenafil without any adverse effects.Sildenafil has been used to facilitate weaning of NO. The combination of sildenafil with potent CYP3A4 inhibitors (e.g. ketoconazole,itraconazole, ritonavir) is contraindicated.

15- ADVERSE REACTIONS

- Cardiovascular System
  flushing, hypotension
- Nervous System
  headache, anterior ischemic optic neuropathy (causing sudden loss of vision)
- Skin
  rash
- Digestive System
  Diarrhoea, dyspepsia

SODIUM BICARBONATE :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Sodium Bicarbonate

3- CLINICAL PHARMACOLOGY:-

Sodium bicarbonate

4- ICU INDICATIONS:-

a- Correction of normal anion gap acidosis

b- Correction of severe metabolic acidosis associated with myocardial dysfunctionwhere acidosis may be contributory to myocardial dysfunction

c- Toxicological indications

i- cardiotoxicity secondary to fast sodium channel blockers

- tricyclics
- bupropion
- venlafaxine
- dextropropoxyphene
- propranolol
- type 1a and 1c antiarrhythmics (flecainide, quinidine and quinine)

ii- prevention of restribution of drug to the CNS

- severe salicylate poisoning

iii- immediate correction of profound life-threatening metabolic acidosis

- cyanide poisoning
- isoniazid poisoning
- toxic alcohol poisoning (ethylene glycol, methanol & other toxic alcohols)

iv- enhanced urinary drug elimination

- salicylate intoxication (any symptomatic patient)
- phenobarbitone intoxication (any symptomatic patient)

v- increased urinary solubility

- methotrexate toxicity
- drug induced rhabdomyolysis

5- PRESENTATION AND ADMINISTRATION:-

- 8.4% (1mmol/ml) 10ml vial and 8.4% 50 & 100ml glass bottles
- Store at room temperature
- Compatible 0.9% sodium chloride and 5% glucose .
- Do not use solutions which are cloudy or have visible precipitate
- Administer via a central line if possible (i.e. if a central line is present this is the preferred route)
- In ICU, it is usual to administer sodium bicarbonate undiluted over an hour; in an emergency situation it can be administered undiluted by direct IV injection.

6- DOSAGE:-

- Usual dose 1mmol/kg IV (repeated as required)
- Alternative method to calculate dose is: Dose (mmol) = 0.3 x Weight(kg) ×deficit (24 –actual HCO3)
- 1mmol = 1mEq
- 1g= 12mEq

Note:- you should give half the previous dose (half correction)

- In severe cardiotoxicity due to fast sodium channel blockade in drug overdose Give 2mmol/kg IV and repeat until cardiovascular stability is achieved

7-DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]

<10 - use with caution
10-20 - dose as in normal renal function
>20-50 - dose as in normal renal function

- Dose in renal replacement therapy
  CAPD - use with caution
  HD - use with caution

8- DOSAGE IN PAEDIATRICS:-

i- If Patient Weight < 5kg
Dose (mmol) = Base Excess x Weight/4
ii- If Patient Weight > 5kg
Dose (mmol) = Base Excess x Weight/6

9- CONTRAINDICATIONS

i- Severe hypernatraemia
ii- Alkalosis
iii- Hypokalaemia

10- WARNINGS :-

- Fluid overload
  Sodium bicarbonate constitutes a significant sodium load and may precipitate Fluidoverload. Patients with poorly controlled congestive cardiac failure, renal failure andacute pulmonary oedema are at particular risk.

11- PRECAUTIONS :-

Alkalosis may precipitate hypokalaemia

12- Laboratory Tests:-

No tests in addition to routine ICU tests are required.

13- Drug/Laboratory Test Interactions :-

None noted.

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

None

15- ADVERSE REACTIONS

- Cardiovascular System:
  Fluid overload, Acute pulmonary oedema
- Respiratory System:
  Respiratory depression, hypoxia (secondary to compensatory respiratory acidosis)
- Metabolic System:
  Alkalosis, hypernatraemia, hypokalaemia, hypocalcaemia, hyperosmolarity
- Local:
  Local tissue inflammation secondary to extravasation

S0DIUM NITROPROSIDE :-

1- ADMINISTRATION ROUTES :-

IV

2- ALTERNATIVE NAMES:-

Nipride, nitropress

3- CLINICAL PHARMACOLOGY:-

The principal pharmacological action of sodium nitroprusside is relaxation of Vascularsmooth muscle and consequent dilation of peripheral arteries and

veins.

4- ICU INDICATIONS:-

i-Afterload reduction / peripheral vasodilation
ii- Treatment of hypertension

5- PRESENTATION AND ADMINISTRATION:-

- 50mg of powder in a vial.
- Add 2-3ml of 5% glucose to dissolve the powder
- Dilute reconstituted solution of 50mg up to a total of 50ml using 5% dextrose.

Note :- Sodium nitroprusside is compatible with 5% dextrose **ONLY**.
No other drug may Be administered via the side arm or added to the infusion while sodium nitroprusside isbeing infused.

- Freshly prepared solution has a very faint brownish tinge
- Prepare all solutions immediately before use.
- In aqueous solution, sodium nitroprusside is photosensitive and must be protected fromlight. Immediately after dilution the solution should be wrapped in aluminium foil toprotect it from light. Use yellow tubing. (it is not necessary to cover the tubing or thedrip chamber with foil)
- Any solution not used within 24 hours or preparation should be discarded.
- Any solutionthat is high coloured should be discarded.
- Store at room temperature
-n Protect from light and heat.

6- DOSAGE:-

- IV infusion

IV infusion dose range is 0-20ml/hr (usually used in the lower end of the dose range).

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function; avoid prolonged use.

8- DOSAGE IN PAEDIATRICS:-

- IV infusion
  - <30kg 3mg/kg in 50ml 5% dextrose at 0.5-4ml/hr (0.5-4mcg/kg/min)
  - >30kg 3mg/kg in100ml 5% dextrose at 1-8ml/hr (0.5-4mcg/kg/min)

9- CONTRAINDICATIONS:-

Known hypersensitivity to sodium nitroprusside

10- WARNINGS :-

- Methaemoglobinaemia
  Rare patients receiving more than 10mg/kg of sodium nitroprusside will Develop methaemoglobinaemia
- Cyanide Poisoning
  Except when used briefly or at low (less than 2micrograms/kg/min) infusion

rates,sodium nitroprusside can give rise to important quantities of cyanide ion, which canreach toxic, potentially lethal levels especially those with impaired renal function afterprolonged, rapid infusions.

- Excessive Hypotension

Sodium Nitroprusside can cause precipitous decreases in blood pressure. Becausesodium nitroprusside's hypotensive effect is very rapid in onset and in dissipation, smallvariations in infusion rate can lead to wide, undesirable variations in blood pressure.

11 PRECAUTIONS :-

- Sodium nitroprusside may lead to severe hypotension in patients with haemodynamically significant aortic stenosis.

12- Laboratory Tests :-

No tests in addition to routine ICU tests are required

13- Drug/Laboratory Test Interactions :-

None of note

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

- Amplification of the vasodilatory effects of sodium nitroprusside by sildenafil can result in severe hypotension.
- Additive effects may be observed when sodium nitroprusside is combined with Other Antihypertensives

15- ADVERSE REACTIONS

- Body as a Whole
  Allergic reactions
- Cardiovascular System
  Tachycardia, hypotension, syncope, rebound hypertension, palpitations
- Gastrointestinal System
  Nausea, vomiting, abdominal pain
- Central Nervous System
  Headache
- Haematological System
  Methaemoglobinaemia, thiocyanate toxicity

SOTALOL :-

1- ADMINISTRATION ROUTES:-

PO, IV

2- ALTERNATIVE NAMES:-

Sotalol, Sotacor

3- CLINICAL PHARMACOLOGY:-

Sotalol hydrochloride is an antiarrhythmic drug with Class II (beta-Adrenoreceptor blocking) and Class III (cardiac action potential duration

prolongation) properties.

4- ICU INDICATIONS:-

Acute treatment and prevention of supraventricular tachycardia

5- PRESENTATION AND ADMINISTRATION:-

i- IV

- Injection vial (40mg/4ml solution)
- Add required dose to an appropriate volume of compatible IV fluid to prepare a solution with a concentration of 0.1-2mg/ml , Infuse over 10 minutes.

Volume of Sotalol Injection	Diluent Volume	Total Volume	Sotalol Concentration
4ml	16ml	20ml	2mg/ml
4ml	36ml	40ml	1mg/ml
4ml	46ml	50ml	0.8mg/ml
4ml	96ml	100ml	0.4mg/ml
8ml	32ml	40ml	2mg/ml
8ml	72ml	8ml	1mg/ml

- Compatible with 0.9% sodium chloride and 5% glucose
- Store at room temperature; if storage is necessary after dilution, refrigerate for no more than 24 hours.

ii- PO

Sotalol 80mg tablets , Sotalol 160mg

6- DOSAGE:-

- IV
  - Individualise dose. 0.5 to 1.5mg/kg (20 – 120mg). Repeat 6 hourly if necessary. Usual maximum daily dose 320mg.
- PO
  - Initially 80mg twice daily; may increase gradually to 240-320mg/day

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  - <10 - Avoid or use with caution
  - 10-20 - 25% of normal dose
  - >20-50 - 50% of normal dose
- Dose in renal replacement therapy
  - CAPD - Avoid
  - HD - Avoid

8- DOSAGE IN PAEDIATRICS:-

- IV
  0.5 - 2mg/kg over 10 minutes 6 hourly
- PO
  1-4mg/kg 8 -12 hourly

9- CONTRAINDICATIONS:-

i- Sinus bradycardia,
ii- Heart block greater than first degree,
iii- Cardiogenic shock,
iv- Overt cardiac failure
v- Asthma

10- WARNINGS :-

i- Proarrhythmia

Like other antiarrhythmic agents, sotalol can provoke new or worsened Ventricular arrhythmias in some patients, including sustained ventricular tachycardia or ventricularfibrillation, with potentially fatal consequences

ii- General

- Cardiac Failure

Sympathetic stimulation is necessary in supporting circulatory function in Congestive heart failure, and beta blockade carries the potential hazard of further depressingmyocardial contractility and precipitating more severe failure.

- Discontinuation of therapy

Discontinuation of therapy in a patient with coronary artery disease may lead to rebound angina, arrhythmia or myocardial infarction.

- Diabetes and Hypoglycaemia

Beta blockers may mask tachycardia occurring with hypoglycaemia.

- Thyrotoxicosis

Beta-adrenergic blockade may mask certain clinical signs (e.g., tachycardia) Of hyperthyroidism. Abrupt withdrawal of beta blockade might precipitate a thyroid storm.

11- PRECAUTIONS :-

Sotalol may aggravate peripheral circulatory disorders

12- Laboratory Tests:-

No tests are required in addition to routine ICU tests

13- Drug/Laboratory Test Interactions:-

The presence of sotalol in the urine may result in falsely elevated levels of Urinary metanephrine when measured by fluorimetric or photometric methods.

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Class Ia antiarrhythmic drugs, such as disopyramide, quinidine and procainamide and other Class III drugs (e.g., amiodarone) are not recommended as concomitant therapywith Sotalol, because of their potential

to prolong refractoriness leading to ventriculararrhythmia. Additive Class II effects would also be anticipated with the use of otherbeta-blocking agents concomitantly with Sotalol.

- Sotalol should be administered with caution in conjunction with calcium blocking Drugsbecause of possible additive effects on atrioventricular conduction or Ventricularfunction. Additionally, concomitant use of these drugs may have additive effects onblood pressure, possibly leading to hypotension
  Beta blockers may exacerbate the rebound hypertension which can follow thewithdrawal of clonidine

15- ADVERSE REACTIONS

- Body as a Whole
  Tiredness, Fatigue
- Cardiovascular System
  Bradycardia, Ventricular tachycardia, Cold extremities, Hypotension, Leg pain
- Respiratory System
  Wheeziness, Dyspnoea
- Digestive System
  Diarrhoea, Nausea
- Nervous System
  Dizziness, Vertigo, Light-headedness

SUXAMETHONIUM :-

1 - ADMINISTRATION ROUTES:-

IV, IM

2- ALTERNATIVE NAMES:-

Succinyl Choline

3- CLINICAL PHARMACOLOGY:

Suxamethonium is a depolarizing skeletal muscle relaxant.

4- ICU INDICATIONS:-

Muscle Relaxant (for rapid sequence induction)

5- PRESENTATION AND ADMINISTRATION :-

- Suxamethonium 100mg/2ml
- Refrigerate - stable at room temperature for 14 days.

6- DOSAGE:-

i- IV
- 1mg/kg

ii- IM
- 3mg/kg

Note :-this is **not** the preferred administration route in ICU and should be used in an emergency only when intravenous/intraosseous access cannot be established.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function; avoid if there is hyperkalaemia

8- DOSAGE IN PAEDIATRICS:-

- IV
  - Neonate: 3mg/kg
  - Child: 2mg/kg

Note: in children, there is a risk of bradycardia and asystole particularly if there Is hypoxia. Suxamethonium should be given with atropine.

9- CONTRAINDICATIONS:-

i- Muscular dystrophy or other skeletal myopathies (including critical illness myopathy)
ii- Personal or family history of malignant hyperthermia
iii- Hypersensitivity to suxamethonium
iv- Acute phase of injury following major burns, extensive denervation of skeletal muscle, or upper motor neuron injury [The risk of hyperkalaemia in these patients increases over time and usually peaks at 7-10 days after the injury. The risk is dependent on the extent and location of the injury. The precise time of onset andthe duration of the risk period are not known.]

10- WARNINGS :-

i- Cardiac arrest in children

There have been rare reports of acute rhabdomyolysis with hyperkalaemia followed by ventricular dysrhythmias, cardiac arrest and death after the administration of suxamethonium to apparently healthy children who were subsequently found to haveundiagnosed skeletal muscle myopathy, most frequently Duchenne's muscular dystrophy. Therefore, when a healthy appearing infant or child develops cardiac arrestsoon after administration of suxamethonium not felt to be due to inadequate ventilation,oxygenation or anaesthetic overdose, immediate treatment for hyperkalaemia should be instituted.

ii- Electrolyte disturbances & digoxin toxicity

Suxamethonium should be administered with GREAT CAUTION to patients

Suffering electrolyte abnormalities and those who may have massive digitalis toxicity, because in these circumstances suxamethonium may induce serious cardiac arrhythmias or cardiac arrest due to hyperkalaemia.

iii- Malignant Hyperthermia

Suxamethonium administration has been associated with acute onset of Malignant hyperthermia, a potentially fatal hypermetabolic state of skeletal muscle.

11- PRECAUTIONS :-

Suxamethonium may cause raised intraocular pressure & raised intracranial pressure

12- Laboratory Tests:-

No tests additional to routine ICU tests are required

13- Drug/Laboratory Test Interactions :-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Drugs which may enhance the neuromuscular blocking action of Suxamethonium include:
  - gentamicin, lithium carbonate, magnesium salt and metoclopramide.
- The neuromuscular blocking effect of suxamethonium may be enhanced by drugs that reduce plasma cholinesterase activity (e.g., chronically administered oral contraceptives, glucocorticoids, or certain monoamine oxidase inhibitors).

15- ADVERSE REACTIONS :-

- General
  Allergic reactions (anaphylactic or anaphylactoid responses), malignant hyperthermia
- Musculoskeletal
  Inadequate block, prolonged block.
- Cardiovascular
  Hypotension, hypertension, vasodilatation (flushing), tachycardia, bradycardia.
- Respiratory
  Respiratory arrest, dyspnoea, bronchospasm, laryngospasm.
- Renal system
  Rhabdomyolysis with possible myoglobinuric acute renal failure

TERLIPRESSIN :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Glypressin

3- CLINICAL PHARMACOLOGY:-

Terlipressin is a synthetic vasopressin analogue with relative specificity for the splanchnic circulation where it causes vasoconstriction. This reduces blood

flowthrough these vessels with a reduction in portal pressure.

4- ICU INDICATIONS:-

Acute variceal bleeding

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - Glypressin lyophilized powder is provided in a 6ml glass vial with a rubber stopper andgreen/silver coloured snap cap. Each vial of powder contains 1mg terlipressin acetate.The diluent is provided in a 5ml glass vial. Substance and diluent are provided together.Mix solvent with powder for injection via the rubber stopper in the vial. The clearreconstituted solution must be injected intravenously immediately after reconstitution.
- Store at room temperature

6- DOSAGE:-

- IV

Terlipressin is administered as an IV bolus 6-hourly. For acute variceal bleeding, thedose is 2mg 6 hourly for the first 24 hours, reducing to 1mg 6 hourly for the second 24hours if bleeding has stabilised. If bleeding has ceased after 48 hours then Terlipressincan be stopped.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

No data available

8- DOSAGE IN PAEDIATRICS:-

Not applicable

9- CONTRAINDICATIONS:-

i- Hypersensitivity to terlipressin
ii- Pregnancy

10- WARNINGS :-

- Low cardiac output

Due is its profound vasoconstrictor effects, terlipressin may lead to reduced Cardiacoutput secondary to increased afterload particularly in the setting of underlying reducedleft ventricular function

11- PRECAUTIONS :-

See WARNINGS

12- Laboratory Tests:-

No tests additional to routine ICU tests are required

13- Drug/Laboratory Test Interactions :-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Concomitant treatment with medicinal products with a known bradycardic effect maylower the heart rate and cardiac output.

15- ADVERSE REACTIONS :-

- Neurological
  Headache
- Cardiovascular
  Bradycardia, atrial fibrillation, ventricular extrasystoles, tachycardia, chest pain,myocardial infarction, fluid overload with pulmonary oedema, torsade de pointes, leftventricular failure, peripheral vasoconstriction, peripheral ischaemia, hypertension,intestinal ischaemia, peripheral cyanosis
- Respiratory
  Respiratory distress, respiratory failure
- Gastrointestinal
  Abdominal pain, nausea, vomiting, diarrhoea
- Metabolic and Endocrine
  Hyponatraemia

TRANEXAMIC ACID :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Cyklokapron

3- CLINICAL PHARMACOLOGY:

Tranexamic acid is an antifibrinolytic.

4- ICU INDICATIONS:-

i- Bleeding post cardiac surgery or other bleeding due to fibrinolysis
ii- Major trauma with significant bleeding risk

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 500mg in 5ml (solution)
  - Preferred method of administration is via direct IV injection at a rate of 1ml (100mg) perminuteCan be administered by intermittent infusion by adding dose to a suitable volume of
- compatible IV fluid and infusing at a rate of 100mg/min
- Compatible with 0.9% sodium chloride and 5% , 10% glucose .
- Store at room temperature.
- Use dilutions in IV fluid within 24 hours of preparation

6- DOSAGE:-

- IV
  - 10-25 mg/kg 8 hourly
  - For major trauma: 1 gm over 10 mins then 1 gm over 8 hrs by infusion

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  - <10 - 10mg/kg 12 hourly
  - 10-20 - 10mg/kg 24 hourly
  - >20-50 - 5mg/kg 24 hourly
- Dose in renal replacement therapy
  - CAPD - 5mg/kg 24 hourly
  - HD - 5mg/kg 24 hourly

8- DOSAGE IN PAEDIATRICS:-

IV
10-20mg/kg 8 hourly

9- CONTRAINDICATIONS:-

i- Previous DVT or PE
ii- Hypersensitivity to tranexamic acid

10- WARNINGS :-

- Procoagulant effects
  Tranexamic acid may cause thrombotic complications; it should be used with caution inpatients at risk of such complications.

11- PRECAUTIONS :-

- General
  See WARNINGS

12 - Laboratory Tests:-

No tests additional to routine ICU tests are required

13- Drug/Laboratory Test Interactions :-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

None known.

15- ADVERSE REACTIONS :-

- Body as a Whole
  Allergic reactions, thrombotic events
- Cardiovascular
  Hypotension (particularly with rapid injection)
- Gastrointestinal
  Nausea, vomiting, diarrhea
- Nervous System:
  Impaired colour vision and other visual disturbances

TRAMADOL :-

1- ADMINISTRATION ROUTES:-

IV, PO, IM, NG

2- ALTERNATIVE NAMES:-

Tramal, Tramadol

3- CLINICAL PHARMACOLOGY:-

Tramadol is a centrally acting synthetic analgesic compound. Although its

mode ofaction is not completely understood, at least two complementary mechanisms appearapplicable: binding of parent and M1 metabolite to opioid receptors and weak inhibitionof reuptake of norepinephrine and serotonin.

4- ICU INDICATIONS:-

Analgesia

5- PRESENTATION AND ADMINISTRATION:-

i- IV / IM

- 100mg in 2ml (solution)
- For IM injection, inject undiluted into large muscle
- For IV administration, dilute in compatible IV fluid and administer by IV injection over 2-3minutes. Alternatively, dilute with a suitable volume of compatible IV fluid andadminister over a convenient time period.
- Compatible with : 0.9% normal saline and 5% dextrose .
- Dilutions in compatible IV fluids are stable for 24 hours at room temperature
- Any solution not used within 24 hours of preparation should be discarded
- Store at room temperature

ii- PO

- Capsules
  - Tramadol 50mg capsules
  - Tramal 50mg capsules
  - Tramedo 50mg capsules
- Sustained Release capsules
  - Tramal SR 50mg, 100mg and 200mg SR capsules
- Oral Drops
  - Tramal oral drops 100mg/ml

6- DOSAGE:-

- IV / PO/ NG

  50-100mg 4-6 hourly

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

- Dose in renal impairment [GFR (ml/min)]
  - <10 - 50mg every 12 hours
  - 10-20 - 50-100mg every 12 hours
  - >20-50 - Dose as in normal renal function
- Dose in renal replacement therapy
  - CAPD - 50mg every 12 hours
  - HD - 50mg every 12 hours

8- DOSAGE IN PAEDIATRICS:-

- IV

  2-3mg/kg stat, then 1-2mg/kg 4-6 hourly

9- CONTRAINDICATIONS:

Hypersensitivity to tramadol

10- WARNINGS

- Seizure Risk

  Seizures have been reported in patients receiving tramadol within the Recommendeddosage range. The risk of convulsions may be increased in patients with epilepsy, thosewith a history of seizures, or in patients with a recognized risk for seizure (such as headtrauma, metabolic disorders, alcohol and drug withdrawal, CNS infections).

- Anaphylactoid Reactions

  Serious and rarely fatal anaphylactoid reactions have been reported in patients receiving therapy with tramadol.

11- PRECAUTIONS :-

- General

  Administer tramadol cautiously in patients at risk for respiratory depression. In cirrhotic patients, dosing reduction is recommended. Reduce dose and / or Increasedosing interval

12- Laboratory Tests:-

No tests additional to routine ICU tests are required

13- Drug/Laboratory Test Interactions

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU

Concomitant use of tramadol increases the seizure risk in patients taking Selectiveserotonin reuptake inhibitors and tricyclic antidepressants. Synergistic with other CNSdepressant drugs. Post-marketing surveillance has revealed rare reports of digoxintoxicity and alteration of warfarin effect, including elevation of prothrombin times.

15- ADVERSE REACTIONS

- Body as a Whole

  Itching

- Cardiovascular

  Hypotension, Tachycardia

- Gastrointestinal

  Nausea, vomiting, diarrhoea, constipation, dry mouth

- Nervous System

  Anxiety, confusion, coordination disturbance, euphoria, headache, seizures

THYROXINE :-

1- ADMINISTRATION ROUTES:-

PO

2- ALTERNATIVE NAMES:-

Eltroxin

3- CLINICAL PHARMACOLOGY:-

Thyroxine is a thyroid hormone.

4- ICU INDICATIONS:-

Treatment of hypothyroidism

5- PRESENTATION AND ADMINISTRATION:

- PO

Eltroxin 50mcg and 100mcg tablets

6- DOSAGE:-

- PO
- Thyroid hormone replacementUsual dosage range 50-200mcg daily

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

- PO

Thyroid hormone replacementUsual dose range is 100mcg/m2 rounded to the nearest quarter tablet daily

9- CONTRAINDICATIONS:-

Uncorrected adrenal insufficiency

10- WARNINGS

- Patients with underlying cardiovascular disease

Exercise caution when administering levothyroxine to patients with Cardiovasculardisorders and to the elderly in whom there is an increased risk of occult cardiac disease.In these patients, levothyroxine therapy should be initiated at lower doses than thoserecommended in younger individuals or in patients without cardiac disease.

11- PRECAUTIONS :-

- General

Levothyroxine has a narrow therapeutic index. Regardless of the indication for use,careful dosage titration is necessary to avoid the consequences of over- or undertreatment.

12- Laboratory Tests:-

It is reasonable to check thyroid hormone levels in patients on thyroxine when they areadmitted to the intensive care unit; however, interpretation of thyroid hormone levels inthe setting of critical illness can be difficult

13- Drug/Laboratory Test Interactions :-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Many drugs affect thyroid hormone pharmacokinetics and metabolism (e.g., absorption,synthesis, secretion, catabolism, protein binding, and target tissue

response) and mayalter the therapeutic response. In addition, thyroid hormones and thyroid status havevaried effects on the pharmacokinetics and actions of other drugs.

i-Drugs That Alter Thyroid Hormone Secretion

- Drugs that may decrease thyroid hormone secretion, which may result in hypothyroidism:

Aminoglutethimide, amiodarone, iodide (including iodine-containing Radiographiccontrast agents), lithium, methimazole, propylthiouracil (PTU), sulfonamides, tolbutamide,Long-term lithium therapy can result in goiter in up to 50% of patients, and eithersubclinical or overt hypothyroidism, each in up to 20% of patients. Oralcholecystographic agents and amiodarone are slowly excreted, producing moreprolonged hypothyroidism than parenterally administered iodinated contrast agents. Long-term aminoglutethimide therapy may minimally decrease T4 and T3 levels andincrease TSH, although all values remain within normal limits in most patients.Drugs that may increase thyroid hormone secretion, which may result in hyperthyroidism Amiodarone, iodide (including iodine-containing radiographic contrast agents):Iodide and drugs that contain pharmacologic amounts of iodide may causehyperthyroidism in euthyroid patients with Grave's disease previously treated withantithyroid drugs or in euthyroid patients with thyroid autonomy (e.g., multinodular goiter or hyperfunctioning thyroid adenoma). Hyperthyroidism may develop over severalweeks and may persist for several months after therapy discontinuation. Amiodaronemay induce hyperthyroidism by causing thyroiditis.

- Drugs that may decrease T4 absorption, which may result in hypothyroidism:

Antacids (aluminum and magnesium); hydroxides (simethicone); bile acid Sequestrants(cholestyramine, colestipol); calcium carbonate; cation exchange resins (kayexalate);ferrous sulfate; sucralfate:
Concurrent use may reduce the efficacy of levothyroxine by binding and delaying orpreventing absorption, potentially resulting in hypothyroidism. Calcium carbonate mayform an insoluble chelate with levothyroxine, and ferrous sulfate likely forms a ferricthyroxinecomplex. Administer levothyroxine at least 4 hours apart from these agents.

- Drugs that may increase serum TBG concentration:

Clofibrate, estrogen-containing oral contraceptives, estrogens (oral), heroin/methadone,5-fluorouracil, mitotane, tamoxifen.

- Drugs that may decrease serum TBG concentration:

Androgens/anabolic steroids, asparaginase, glucocorticoids, slow-release nicotinic acid.

- Drugs that may cause protein-binding site displacement:

Frusemide (>80 mg IV); heparin; hydantoins; non-steroidal anti-inflammatory

- Drugs(fenamates, phenylbutazone); salicylates (>2 g/day):

Administration of these agents with levothyroxine results in an initial transient

Increasein FT4. Continued administration results in a decrease in serum T4 and normal FT4 andTSH concentrations and, therefore, patients are clinically euthyroid. Salicylates inhibitbinding of T4 and T3 to TBG and transthyretin. An initial increase in serum FT4 isfollowed by return of FT4 to normal levels with sustained therapeutic serum salicylateconcentrations, although total-T4 levels may decrease by as much as 30%

- Drugs that may increase hepatic metabolism, which may result in hypothyroidism: Carbamazepine, hydantoins, phenobarbital, rifampin:
Stimulation of hepatic microsomal drug-metabolizing enzyme activity may Causeincreased hepatic degradation of levothyroxine, resulting in increased Levothyroxinerequirements. Phenytoin and carbamazepine reduce serum protein binding oflevothyroxine, and total- and free-T4 may be reduced by 20-40%, but most patientshave normal serum TSH levels and are clinically euthyroid.
- Drugs That May Decrease T4 5 alpha-Deiodinase ActivityAmiodarone; beta-adrenergic antagonistsAdministration of these enzyme inhibitors decreases the peripheral conversion of T4 toT3, leading to decreased T3 levels. However, serum T4 levels are usually normal butmay occasionally be slightly increased. In patients treated with large doses ofpropranolol (>160 mg/day), T3 and T4 levels change slightly, TSH levels remain normal,and patients are clinically euthyroid. It should be noted that actions of particular beta adrenergicantagonists may be impaired when the hypothyroid patient is converted tothe euthyroid state. Short-term administration of large doses of glucocorticoids maydecrease serum T3 concentrations by 30% with minimal change in serum T4 levels.However, long-term glucocorticoid therapy may result in slightly decreased T3 and T4levels due to decreased TBG production
- Miscellaneous
  - Anticoagulants coumarin derivatives, indandione derivatives:
Thyroid hormones appear to increase the catabolism of vitamin K-dependent Clottingfactors, thereby increasing the anticoagulant activity of oral anticoagulants. Concomitantuse of these agents impairs the compensatory increases in clotting factor synthesis.Prothrombin time should be carefully monitored in patients taking levothyroxine and oral anticoagulants and the dose of anticoagulant therapy adjusted accordingly.
  - Antidepressants tricyclics
Concurrent use of tri/tetracyclic antidepressants and levothyroxine may increase thetherapeutic and toxic effects of both drugs, possibly due to increased receptor sensitivityto catecholamines. Toxic effects may include increased risk of cardiac arrhythmias andCNS stimulation; onset of action of tricyclics may be accelerated. Administration ofsertraline in patients stabilized on levothyroxine may result in increased levothyroxinerequirements.
  - Antidiabetic agents
biguanides, meglitinides, sulfonylureas, thiazolidediones, insulin:
Addition of levothyroxine to antidiabetic or insulin therapy may result in Increasedantidiabetic agent or insulin requirements. Careful monitoring of diabetic control isrecommended, especially when thyroid therapy is started, changed, or discontinued.
- Cardiac glycosides

Serum digitalis glycoside levels may be reduced in hyperthyroidism or when Thehypothyroid patient is converted to the euthyroid state. Therapeutic effect of digitalisglycosides may be reduced.

- Ketamine:
  Concurrent use may produce marked hypertension and tachycardia; cautious administration to patients receiving thyroid hormone therapy is recommended.
- Methylxanthine bronchodilators
  Decreased theophylline clearance may occur in hypothyroid patients; clearance returnsto normal when the euthyroid state is achieved.
- Radiographic agents
  Thyroid hormones may reduce the uptake of 123I, 131I, and 99mTc.
- Sympathomimetics
  Concurrent use may increase the effects of sympathomimetics or thyroid hormone.Thyroid hormones may increase the risk of coronary insufficiency whensympathomimetic agents are administered to patients with coronary artery disease.

15- ADVERSE REACTIONS :-

Adverse reactions associated with levothyroxine therapy are primarily those of hyperthyroidism due to therapeutic overdosage.

- General:
  Fatigue, increased appetite, weight loss, heat intolerance, fever, excessive sweating.
- Central Nervous System:
  Headache, hyperactivity, nervousness, anxiety, irritability, emotional lability, insomnia.
- Musculoskeletal
  Tremors, muscle weakness.

- Cardiovascular
  Palpitations, tachycardia, arrhythmias, increased pulse and blood pressure, Heartfailure, angina, myocardial infarction, cardiac arrest.
- Respiratory
  Dyspnea.
- Gastrointestinal
  Diarrhoea, vomiting, abdominal cramps and elevations in liver function tests.
- Dermatologic
  Hair loss, flushing.
- Endocrine
  Decreased bone mineral density.
- Reproductive
  Menstrual irregularities, impaired fertility.

THIOPENTONE :-

1- ADMINISTRATION ROUTES:-

IV, IM, PO

2- ALTERNATIVE NAMES:-

Thiopentone

3- CLINICAL PHARMACOLOGY:-

- Thiopental is an ultrashort-acting depressant of the central nervous system Whichinduces hypnosis and anaesthesia, but not analgesia. It produces hypnosis within 30-40seconds of intravenous injection.

- Repeated intravenous doses lead to prolongedanaesthesia because fatty tissues act as a reservoir; they accumulate thiopental inconcentrations 6-12 times greater than the plasma concentration, and then release thedrug slowly to cause prolonged anaesthesia.

4- ICU INDICATIONS:-

i- Induction of anaesthesia
ii- Treatment of status epilepticus refractory to other measures (rarely used for this indication)
iii- Treatment of intracranial hypertension (rarely used for this indication in our ICU)

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 500mg vials for reconstitution
  - Reconstitute with Water for Injection
  - For IV injection dilute 500mg to a total of 20ml using Water for Injection (makes asolution with a concentration of 25mg/ml)
  - Store at room temperature

Note:-Section 29 drug when administered IV (requires specific notification to Director-General of Health as unapproved route of administration)

6- DOSAGE:-

- IV

2-5mg/kg slowly stat. In unstable patients (i.e. most ICU patients) administer 75mg at atime then assess effect on blood pressure and conscious state before administeringmore.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:

- IV

2-5mg/kg slowly stat

9- CONTRAINDICATIONS:-

i- Hypersensitivity to thiopentone
ii- Acute intermittent porphyria

10-WARNINGS :-

- Hypotension

Administer with caution in haemodynamically unstable patients

11- PRECAUTIONS :-

- General

Use with care in patients with reduced left ventricular function

12- Laboratory Tests:-

No tests additional to routine ICU tests are required

13- Drug/Laboratory Test Interactions :-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Thiopentone has a synergistic action with other CNS depressant drugs.

15- ADVERSE REACTIONS

- Body as a Whole
  Anaphylactic and anaphylactoid reactions
- Cardiovascular
  Hypotension, myocardial depression, arrhythmias
- Respiratory
  Respiratory depression, coughing, bronchospasm and laryngospasm
- Skin
  Urticaria.

VASOPRESSIN :-

1- ADMINISTRATION ROUTES:-

IV

2- ALTERNATIVE NAMES:-

Pitressin

3- CLINICAL PHARMACOLOGY:-

Vasopressin is a potent vasopressor which is an analogue of the posterior Pituitaryhormone ADH. Vasopressin binds to different receptors than the Catecholaminepressors. Vasoconstrictor effects are through the V1 vascular

receptors

4- ICU INDICATIONS :-

i- Refractory septic shock
ii- Severe post cardiopulmonary bypass vasoplegia

5- PRESENTATION AND ADMINISTRATION:-

- IV
  - 20 units in 1ml glass vials
  - Administer by IV infusion. Make 20 units of vasopressin up to a total of 20ml Ofcompatible IV fluid.
  - Compatible with 5% dextrose and normal saline
  - Administer via a central line.
  - Store at room temperature

Note: Section 29 drug (requires specific notification to Director-General of Health)

6- DOSAGE:-

- IV

0-2 units/hr

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

- IV

Vasopressin has been shown to increase the risk of death in children with septic shock;it should not be used except on the advice of a Paediatric Intensivist (i.e. StarshipConsultant)

8- CONTRAINDICATIONS:-

hypersensitivity to vasopressin

9- WARNINGS :-

See PRECAUTIONS

10- PRECAUTIONS :-

Vasopressin is a potent vasoconstrictor. Due to its effect on afterload, vasopressin mayincrease myocardial oxygen demand and lead to myocardial ischaemia.

11- Laboratory Tests :-

No tests are required in addition to routine ICU tests.

12- Drug/Laboratory Test Interactions :-

None know

13- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Vasopressin acts via different receptors than other vasoconstrictor agents;

it may leadto significant reductions in noradrenaline requirements.

14- ADVERSE REACTIONS :-

- Cardiovascular
  Arrhythmias including asystole, hypertension, reduced cardiac output, chest pain, MI,venous thrombosis
- Central nervous system
  Pounding in head, fever, vertigo.
- Dermatologic
  Ischemic skin lesions, circumoral pallor, urticaria
- Gastrointestinal
  Abdominal cramps, flatulence, mesenteric ischemia, nausea, vomiting
- Genitourinary
  Uterine contraction
- Neuromuscular & skeletal
  Tremor
- Respiratory
  Bronchial constriction
- Metabolic
  Hyponatraemia & water retention

VITAMIN K :-

1- ADMINISTRATION ROUTES:-

IV, PO

2- ALTERNATIVE NAMES:-

Phytomenadione, Konakion

3- CLINICAL PHARMACOLOGY:-

- Vitamin K is an essential cofactor for a microsomal enzyme that catalyzes the Posttranslationalcarboxylation of multiple, specific, peptide-bound glutamic acid residues ininactive hepatic precursors of factors II, VII, IX, and X.

The resulting gammacarboxyglutamicacid residues convert the precursors into active coagulation factorsthat are subsequently secreted by liver cells into the blood.

4- ICU INDICATIONS:-

Correction of elevated INR due to administration of warfarin or liver impairment

5- PRESENTATION AND ADMINISTRATION:

i- IV

- 2mg in 0.2ml vials and 10mg in 1ml vials
- Usually administered in ICU by direct IV injection. Administer undiluted by very slow IVpush over at least 30 seconds either direct or, where appropriate, into lower section ofinfusion set of a continuous infusion of normal saline or 5% glucose.
- Compatible when injected into Normal saline 5% glucose
- Store at room temperature.

ii- PO

-Konakion 10mg tablets (white to yellowish)

6- DOSAGE:-

- IV/ PO:
  - 0.5-10mg; repeated as necessary (avoid large doses if anticoagulation is to becontinued).

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function

8- DOSAGE IN PAEDIATRICS:-

For warfarin reversal: 0.1mg/kg (max 5mg) IV or oral

9- CONTRAINDICATIONS:-

Hypersensitivity to the drug

10- WARNINGS :-

An immediate coagulant effect should not be expected after administration of vitamin K.
Whole blood or component therapy is necessary if the patient is bleeding.
Repeated large doses of vitamin K are not warranted in liver disease if the response to
initial use of the vitamin is unsatisfactory. Failure to respond to vitamin K may indicate
that the condition being treated is inherently unresponsive to vitamin K.

11- PRECAUTIONS :-

Allergic reactions can occur with IV administration

12- Laboratory Tests:-

No tests in addition to routine ICU tests are indicated

11- Drug/Laboratory Test Interactions:-

No tests additional to routine ICU tests are required.

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

Temporary resistance to prothrombin-depressing anticoagulants may result, Especiallywhen larger doses of vitamin K are used. If relatively large doses have been employed,it may be necessary when reinstituting anticoagulant therapy to use somewhat largerdoses of the prothrombin-depressing anticoagulant, or to use one which acts on adifferent principle, such as heparin.

15- ADVERSE REACTIONS :-

- Body as a Whole

Transient "flushing sensations" and "peculiar" sensations of taste have been observed,as well as rare instances of dizziness, rapid and weak pulse, profuse sweating, briefhypotension. The possibility of allergic sensitivity, including an anaphylactoid reaction,should be kept in mind.

- Respiratory System

Dyspnoea.

- Local

Pain, swelling, and tenderness at the injection site may occur.

VERAPAMIL :-

1- ADMINISTRATION ROUTES:-

PO, IV

2- BRAND NAMES:-

Isoptin, Isoptin SR, Verpamil SR

3- CLINICAL PHARMACOLOGY:-

Verapamil is a calcium ion influx inhibitor. It decreases the influx of ionic calcium acrossthe cell membrane of arterial smooth muscle as well as conductile & contractilemyocardial cells. It dilates the main coronary arteries & inhibits coronary artery spasm. Italso reduces afterload so reducing myocardial energy consumption. By decreasingcalcium influx

through the slow channels of the AV node, the effective refractory period is increased so AV conduction is slowed in a rate-related manner.
It has no effect on thenormal atrial action potential or intraventricular conduction time.

4- ICU INDICATIONS:-

i- Tachycardias including paroxysmal SVT, AF with rapid ventricular response (excluding WPW syndrome), atrial flutter with rapid ventricular response, extrasystoles
ii- Hypertension
iii- Acute coronary insufficiency

5- PRESENTATION AND ADMINISTRATION:-

i- Oral
- Isoptin 40mg (white), 80mg (white)
- Isoptin SR 240mg (light green)
- Verpamil SR 120mg (white biconvex), 240mg (light green biconvex)

ii- IV
- Isoptin 5mg in 2ml solution

6- DOSAGE:-

i- Oral
- Administer in 2-3 divided doses.
- Hypertension: 240-480mg/day, 160mg maximum single dose
- Angina: 360-480mg/day

ii- IV:
Injection: 5mg undiluted solution slowly over 2 minutes (longer in elderly) Withcontinuous ECG & blood pressure monitoringCan repeat if necessary after 5-10 minutes

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

No dose adjustment is required

8- DOSAGE IN PAEDIATRICS:-

Oral 1-3mg/kg 8-12 hourly

9- CONTRAINDICATIONS:-

i- Severe LV dysfunction
ii- Hypotension (systolic <90mmHg) or cardiogenic shock
iii- Sick sinus syndrome (except in patients with a functioning external ventricularpacemaker)
iv- Second- or third-degree AV block (except in patients with a functioning externalventricular pacemaker)
v- Atrial flutter or atrial fibrillation and an accessory bypass tract (Wolff-Parkinson-White, Lown-Ganong-Levine syndromes)
vi- Known hypersensitivity to verapamil

10- WARNINGS:-

The negatively inotropic effects of verapamil are mostly compensated for by its afterload reduction without a net impairment of LV performance. It should be used in caution with patients with severe LV dysfunction (LVEF<30%), moderate to severe symptoms ofcardiac failure, and in any patients with dysfunction also receiving beta-blockers.Very rapid ventricular responses or VF have been described in patients with coexistingaccessory AV pathways that may not become apparent until the administration ofverapamil.
First-degree AV block with transient bradycardia may be seen, sometimes accompanied by nodal escape rhythms. PR-interval prolongation corresponds withverapamil plasma concentrations. Serious adverse effects (including death) have been recorded in a series of patients with hypertrophic cardiomyopathy receiving verapamil.
Elevation of liver enzymes have been reported.

11- PRECAUTIONS :-

Severe liver dysfunction prolongs elimination half-life; 30% of the dose should Beadministered to these patients. Verapamil decreases neuromuscular transmission inDuchenne's muscular dystrophy.

12- Laboratory Tests :-

No tests are required in addition to routine ICU blood tests

13- Drug/Laboratory Test Interactions:-

None known

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Alcohol: may increase blood alcohol concentrations & prolong its effects
- Beta-blockers: may result in additive negative effects on hear rate, AV conduction &cardiac contractility.
- Digoxin: chronic verapamil usage can increase serum digoxin levels by 50-75% duringfirst week of therapy. Effects exaggerated in hepatic cirrhosis.
- Disopyramide: should not be given within 48 hours before or 24 hours after verapamil
- Lithium: increased sensitivity to the effects of lithium (neurotoxicity) reported
- Carbamazepine: levels may be increased by verapamil
- Rifampicin: markedly reduces oral verapamil bioavailability
- Cyclosporin: levels may be increased by verapamil
- Theophylline: levels may be increased by verapamil
- Neuromuscular blocking agents: verapamil may prolong the duration of action

15- ADVERSE REACTIONS :-

- Nervous system
  CVA, confusion, insomnia, parasthesiae
- Cardiovascular
  Angina, AV dissociation
- Digestive
  Diarrhoea, dry mouth, gingival hyperplasia

- Skin
  Rash, hair loss, Stevens-Johnson syndrome, erythema multiforme
- Urogenital
  Gynaecomastia, impotence

WARFARIN SODIUM :-

1- ADMINISTRATION ROUTES:-

PO, NG

2- BRAND NAMES:-

Coumadin, Marevan

3- CLINICAL PHARMACOLOGY:-

- Warfarin sodium acts by inhibiting the synthesis of vitamin K dependent clotting factorswhich include Factors II, VII, IX and X, and the anticoagulant

proteins C and S.Therapeutic warfarin doses decrease the total amount of the active form of each vitaminK dependent factor made by the liver by approximately 30-50%. An anticoagulant effectgenerally occurs within 24 hours after drug administration, however peak anticoagulanteffect may be delayed by 72-96 hours. The duration of action of a single dose of warfarin is 2-5 days.

- Warfarin may potentiate a more hypercoagulable state in the first 24-48 hours due tothe more rapid depletion of the anticoagulant proteins C & S when compared to theclotting factors with longer half-lives. As such, any concomitant anticoagulant therapysuch as Heparin or Enoxaparin should be continued until the desired therapeutic INR isreached.

  This initial pro-coagulant effect is increased with the use of higher loading doses.Warfarin may increase the APTT test even in the absence of heparin.
- Heparin therapymay also affect the INR.
  Anticoagulants have no direct effect on established thrombus but prevent Furtherextension of the formed clot.

4- ICU INDICATIONS:

Anticoagulation for prophylaxis and/or treatment of venous thrombosis, Pulmonaryembolism, thromboembolism associated with atrial fibrillation or prosthetic valveinsertion.

5- PRESENTATION AND ADMINISTRATION:-

- PO
  - Coumadin 1mg (beige), 2mg (lavender) and 5mg (green) tablets
  - Marevan 1mg (brown), 3mg (blue) and 5mg (pink) tablets

6- DOSAGE:-

i- The dosage is individualised according to the patient's sensitivity to the drug Asindicated by their INR. Most patients are satisfactorily maintained with a dose of 2 to10mg daily.
Several studies have shown that a loading regimen of 5mg/5mg/5mg produces atherapeutic INR by day 4 to 5 as rapidly as higher dosed regimens but with a reducedrisk of bleeding complications. In patients after cardiac surgery, a loading regimen of2.5mg for the first 2 days with the third dose adjusted only if the INR was <1.5 or >3.0has been shown to reduce excessive anticoagulation; this is the recommended dosingschedule in these patients

ii- Recommended INR ranges:
DVT andPE ---- 2.0-3.0!
Atrial fibrillation --- 2.0-3.0
Bioprosthetic heart valves --- 2.0-3.0
Mechanical heart valves --- 2.5-3.5

iii- An INR greater than 4.0 appears to provide no additional therapeutic benefit in mostpatients & is associated with a higher risk of bleeding.

iv- Duration of therapy is individualised and in general should be continued until the

Dangerof thrombosis & embolism has passed.

7- DOSAGE IN RENAL FAILURE AND RENAL REPLACEMENT THERAPY:-

Dose as in normal renal function. Active metabolites may accumulate in renal failure.**Not dialysed.**

8- DOSAGE IN PAEDIATRICS:-

- Day 1 --- 0.2mg/kg single dose
Day 2 --- 0.2mg/kg single dose providing INR<1.3
Day 3 & onwards -- 0.05-0.2mg/kg single dose titrated to INR

9- CONTRAINDICATIONS:-

Any condition in which the hazard of haemorrhage is greater than the potential Clinical benefits of anticoagulation, such as:

i- Pregnancy, threatened abortion, eclampsia and pre-eclampsia
ii- Haemorrhagic tendencies or blood dyscrasias
iii- Sever to moderate hepatic or renal insufficiency
iv- Recent or contemplated surgery of the CNS, eye or traumatic surgery resulting inlarge open surfaces
v- Bleeding tendencies associated with active ulceration or overt bleeding of gastrointestinal/genitourinary or respiratory tracts, cerebrovascular haemorrhage,cerebral aneurysms, dissecting aorta, pericarditis and pericardial effusions,bacterial endocarditis
vi- Inadequate laboratory facilities
vii- Unsupervised senility, alcoholism, psychosis or lack of patient co-operation
viii- Spinal puncture
ix- Malignant hypertension
x- Known or suspected deficiency in protein C
xi- Known hypersensitivity to warfarin

10- WARNINGS:-

- Risk of haemorrhage in any tissue or organ related to level of intensity & duration ofanticoagulant therapy. Necrosis & gangrene of skin and other tissues is seen lessfrequently (<0.1%) and usually appears within a few days of the start of therapy.
- Therapy in each patient is highly individualised and regular INR monitoring is requireddue to the narrow therapeutic index of warfarin which may be easily affected by otherdrugs and dietary vitamin K.

11- PRECAUTIONS :-

- Patients of 60 years or older appear to exhibit a greater than expected INR response tothe anticoagulant effects of warfarin for reasons unknown.
- An increased INR response may also be seen with cancer, congestive heart failure,
- hyperthermia, hyperthyroidism and in patients with a poor nutritional state.
- A decreased INR response may be seen with oedema, hyperlipidaemia and Hypothyroidism

12- Laboratory Tests :-

Therapeutic effect is monitored by regular measurement of the INR

13- Drug/Laboratory Test Interactions :-

None

14- IMPORTANT DRUG INTERACTIONS FOR THE ICU :-

- Drugs that may cause an **increased** INR include:

  Alcohol, allopurinol, amiodarone, aspirin, azithromycin, cephazolin, ceftriaxone,chloramphenicol, chloral hydrate, ciprofloxacin, clarithromycin, diclofenac, doxycycline,erythromycin, fluconazole, fluoxetine, glucagon, heparin, ibuprofen, indomethacin,
  influenza flu vaccine, itraconazole, ketorolac, methyldopa, metronidazole, naproxen,neomycin, omeprazole, paracetamol, paroxetine, penicillin G (intravenous), phenytoin,prednisone, propranolol, quinine, ranitidine, simvastatin, tamoxifen, tetracycline, thyroiddrugs, tramadol, valproate

- Drugs that may cause a **decreased** INR include:

  Alcohol, atorvastatin, azathioprine, carbamazepine, chloral hydrate, clozapine, cortisone, haloperidol, phenobarbitone, prednisone, rifampicin, spironolactone, sucralfate, vitamin C (high dose), vitamin K

15- ADVERSE REACTIONS

- Nervous system

  Headache, dizziness.
  Haemorrhagic complications may present as headache, paralysis, paraesthesia
  Oraltered consciousness & need to be excluded.

- Cardiovascular

  None described

- Digestive

  Nausea, vomiting, diarrhoea, flatulence, bloating

- Skin

  Necrosis, bullous eruptions, urticaria, pruritus, alopecia

GOOD LUCK